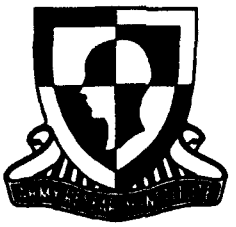

Research Product 94-06

Evaluation of the AirLand Battle Management Advanced Technology Demonstration Prototype Version 1.2: Human Factors Assessment of the Soldier Machine Interface

April 1994

Field Unit at Fort Leavenworth, Kansas
Manpower and Personnel Research Division

U.S. Army Research Institute for the Behavioral and Social Sciences

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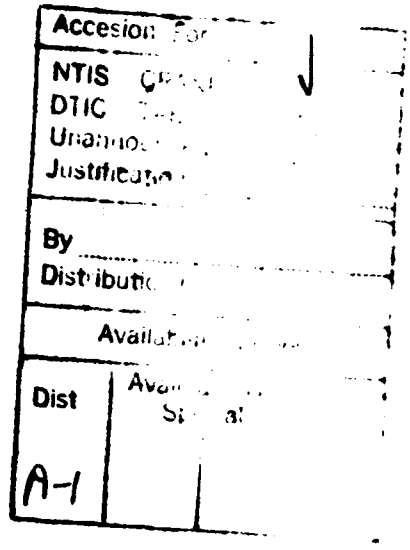

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13. ABSTRACT (Maximum 200 words)

This report documents the results of an early human factors assessment of the Soldier Machine Interface of the AirLand Battle Management (ALBM) Advanced Technology Demonstration (ATD) decision aid prototype, version 1.2. This is one of a series of assessments of the ALBM ATD prototype conducted during its development. An assessment instrument was developed to evaluate compliance to several sources of interface design guidelines and principles, both military and nonmilitary. Using the assessment instrument, a human factors specialist collected evaluation data. In addition to specific recommendations for interface improvement, suggestions are made for improved interface development procedures.

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FOREWORD

This document contains the results of an early human factors assessment of the Soldier Machine Interface of the AirLand Battle Management (ALBM) Advanced Technology Demonstration (ATD) prototype, version 1.2. ALBM ATD is a program to develop decision aid prototypes to support Army division-level tactical planning. This assessment is one of a series of life cycle assessments of ALBM ATD being conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) during the development of the system. The results will be used by the developer and government sponsored of ALBM ATD to guide further development of the system.

The research was conducted under the ARI research task entitled "Support for Command and Control Research." The assessment was in support of the Combined Arms Command (CAC), the program's user representative. A Memorandum of Agreement was in effect with the Combined Arms Combat Developments Activity, "Development and Implementation of the Future Battle Laboratory," dated 30 June 1989. The results of this review were briefed to personnel from the Battle Command Battle Laboratory, Combined Arms Command; Communications and Electronics Command; Lockheed; and MITRE on 7 January 1993. Brigadier General Anderson, Deputy Commanding General for Combat Developments, Combined Arms Center, was briefed on the findings presented in this report on 25 January 1993.

EDGAR M. JOHNSON
Director

EVALUATION OF THE AIRLAND BATTLE MANAGEMENT ADVANCED TECHNOLOGY DEMONSTRATION PROTOTYPE VERSION 1.2: HUMAN FACTORS ASSESSMENT OF THE SOLDIER MACHINE INTERFACE

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Summary

This study assessed the application of human factors standards to the soldier machine interface (SMI) of the AirLand Battle Management Advanced Technology Demonstration (ALBM ATD) prototype, version 1.2. The purpose of the assessment was to identify human factors problems early in the development of the prototype and make recommendations for improvement. The study was performed as part of the U.S. Army Research Institute for the Behavioral and Social Sciences' (ARI) support of the Battle Command Battle Laboratory (BCBL) in BCBL's role as the ALBM ATD program's user representative.

First, an assessment instrument was developed to evaluate the SMI. System documentation and design requirements materials were reviewed with attention to SMI requirements. Because ALBM ATD had no specific interface design requirements, a rating scale was derived from military and nonmilitary guidelines (i.e., DoD Human-Computer Interface Style Guide--Version 2.0 (Avery & Bowser 1992), Smith & Mosier's Guidelines for Designing User Interface Software (1986), Human Factors Design Guidelines for the Army Tactical Command and Control (ATCCS) Soldier-Machine Interface (1990), and MIL-STD-1472D (1989). Data were collected by a human factors specialist who observed a demonstration of the system and evaluated the interface using the rating scale.

In general, the results revealed the main problems with the SMI stemmed from inconsistent application of the principles and guidelines for good interface design. These inconsistencies were prevalent in the areas of interactive control actions, screen design, data protection and user guidance. Based on the results of the assessment, several recommendations are made:

- a set of human factors guidelines for SMI development and conventions for screen displays should be adopted and followed by the developer,
- the interface deficiencies noted in this report should be corrected,
- human factors reviews should be continued throughout the development of ALBM ATD,
- the developer should conduct in-house reviews or quality control assessments during development.

Introduction

This report documents a human factors evaluation by the U.S. Army Research Institute (ARI) of the ALBM ATD Version 1.2 soldier-machine interface (SMI). It is an evaluation early in the developmental life cycle of ALBM ATD. As such, the results can provide a basis for decisions concerning the human factors design and for improvements in the SMI as the system is readied for more formal and systematic evaluation. The assessment results also serve as a basis on which to identify some of the basic design issues that should be considered in the design of battlefield decision aid applications.

This assessment is one of six assessments of version 1.2 of the ALBM ATD prototype. The assessments are part of a set of life cycle evaluations being conducted on the ALBM ATD prototype as it is being developed. The six assessments conducted on the version 1.2 prototype include knowledge base reviews of four tools, a human factors assessment of the interface, and a user and SME review of demonstrated prototype capabilities. In addition to this report, these assessments are documented in separate ARI reports (Flanagan, in preparation; McKeown, in preparation-a, in preparation-b; Riedel, McKeown, Flanagan, & Adelman, in preparation).

Background

Traditionally, computer systems have been designed with little or no attention given to the interface between the human operator and the machine. The expectation was that the human would "fit" the machine, not that the machine would fit the human. This led to computer systems that were unsystematic, inconsistent, and that failed to reflect human perceptual and processing capabilities. As a result, the systems were difficult to use and actually decreased human productivity (Galitz, 1989).

With the increased use of computer systems in the home and workplace, the importance of good human-computer interface design became apparent. A poorly designed interface decreases productivity, increases errors, increases confusion and boredom, and may even lead to refusing to use the system at all. Galitz (1989) estimated that a 1 second increase in processing time due to a poorly designed screen could add approximately 1 additional man year to process all screens in the system. In addition, Tullis (1981) showed that improvements in screen design (e.g., displaying key information in prominent locations, displaying or chunking together logically-related data, presenting information as concisely as possible) reduced the decision making time of highly practiced workers.

The problems associated with poor human-computer interface design are reflected in the development of military computer systems as well. Most of the developmental effort and money in the military has been focused on hardware and software development with little or no attention given to the human

operator. It is this lack of attention to the human operator in most system development efforts that led to MANPRINT. With MANPRINT, human performance is an "integral part of total system performance. Battlefield effectiveness depends just as much on the ability of the soldier as it does on the capabilities of the system itself" (Stewart & Shvern, unpublished manuscript, p. 2).

Even with the advent of MANPRINT guidelines and principles, human factors analyses are not done early enough, are not applied consistently among military development programs, and are sometimes not performed at all. To be successful, human factors analysis must be a mandated part of system development, and be performed early in system development - to help identify potential problems while there is still time and money available to correct them. Incorporating human factors analyses early in system development also result in reduced system costs. Most of the life cycle cost of system development (approximately 70%) is determined by Milestone I, and any major changes to the system after that (due to poor design) will be costly at a point when only 30% of the budget is left (AMSAA, 1984).

ALBM ATD Software Description

The ALBM ATD software under development, at the time of this assessment, consists of two decision aids to assist commanders and their staffs in planning tactical operations (ALBM ATD FDRS, 1992). The two aids, Force Level Control (FLC) Advisors, are being developed in phases which are managed to enable evolutionary artificial intelligence (AI) technology transition. FLC Advisors function as intelligent assistants which can, when requested, (1) automatically complete straightforward, detailed sections of plans, (2) automatically detect certain inconsistencies and unattainable goals in user-specified plans, and (3) automatically determine suggestions for plan alternatives and provide plan detail expansion and check sheets for user-specified partial plans during the course of action generation process. When embedded in the Army Tactical Command and Control System (ATCCS), the system is intended for use at echelons of command from brigade through corps with initial focus at the division level.

The two FLC Advisors under development are a set of Mission, Enemy, Terrain, Troops, and Time Available Tools (MET4) and the Force Interactive Tactical Evaluator (FITE). MET4 is designed to aid commanders and their staffs from brigade through corps to analyze the area of operations and to assess the enemy and friendly capabilities. FITE interacts with MET4 to aid commanders and their staffs from brigade through corps to develop, wargame, and compare COAs. It also aids commanders and their staffs to properly synchronize operations of subordinate and supporting units in order to concentrate combat power at the critical place and time to accomplish the commander's intent.

Because the system is still undergoing development, only the MET4 Tools were available for evaluation. The MET4 Tools had the

following limited operational capability (Lockheed Austin Division, 1992):

On-line help. There are two general types of help available. The first is a top-level help function that gives instructions on how to use Help (i.e., Help On Help) and gives an overview of the FLC Advisor Capabilities. The second type of help is job-specific, tailored to major tasks or screens including general information on how to use buttons or menus (i.e., Systems Help), information on operations (e.g., reference tables, Ops models), and an explanation of system suggestions.

Map and Overlay Display Capabilities. This capability provides display and database access to maps, terrain databases, and map overlays (e.g., Digital Terrain Elevation Data or DTED, Interim Terrain Data or ITD, Tactical Decision Aids or TDA) through the Geographic Information System (GIS).

Weather Analysis Tool. Through this tool, the user enters weather patterns and observes their expected tactical effects. It automatically checks user inputs for inconsistencies, such as when the user indicates weather conditions with several inches of snow when the temperature is too high for snow to occur.

Movement Analysis Tool. This tool generates an avenue of approach (AA) when the user enters a force template and an initial location and objective. The AA Generation tool then applies data from Tactical Decision Aids, doctrinal rules, and terrain data to generate a satisfactory AA on a map overlay.

AA Comparison Tool. Through this tool, one or more AAs are assessed. The AAs are compared based on knowledge from terrain and operations analyses built into the tool. An additional function of the tool allows an experienced user to develop the criteria and judgements used to compare the AAs.

Location Analysis Capabilities. This tool provides the user access to terrain data displays, searches for high or other elevation patterns, line of sight analyses, distance measurement, and queries for interim terrain data by category for a point or area, without traversing the Map and Overlay Display menu structure.

Friendly Situation Capabilities Analysis Tools. This capability contains the Unit Status Database, the Unit Status Projector tool, the Task Organization tool, and the Combat Power Value tool. The Unit Status Projector tool projects unit status in the form of summary tables (e.g., personnel loss, fuel consumption, ammunition consumption, equipment loss). The user enters a start time and assigns units to phase points associated with a particular plan. The Combat Value tool compares the relative combat power of friendly and enemy units. The calculated combat ratios for both friendly and enemy units are displayed in a summary table. The Task Organization tool presents the friendly and enemy task organizations found in the Unit Status Database. It is used with the Unit Status Projector and Combat Power Value tools; it allows an user to select friendly and enemy units.

General Purpose Tools. A briefing support tool is available in the current ALBM ATD. It allows the user to file screen copies as "slides" to be used, for example, in a briefing or for documentation. Also available are clocks, a calculator, a calendar, and an interim text editor (EMACS) for document preparation.

Description of ALBM ATD Soldier Machine Interface

At the top-level, the ALBM ATD system concept reflects an application tools approach. That is, the user interacts with the system through a series of tools such as the AA Comparison Tool and the Unit Status Projector Tool. The primary interaction between user and computer is direct manipulation. In direct manipulation, the user points at objects or actions and immediately observes the results (Galitz, 1989).

The overall design of the screens is based on the OSF/Motif guidelines. The basic elements of the ALBM ATD interface are overlapping windows, menus, and operator action selections (e.g., buttons, list boxes, dialog boxes) accessed primarily with a mouse. Some form filling is also available. At present, there is a limited capability to access menu options through the keyboard.

Maps and display overlays are the primary characteristic of the ALBM ATD SMI. Frequently, the system responds to user inputs in the form of graphics displayed on static map backgrounds. For example, users define the parameters needed to generate an AA (e.g., starting point, objective). The system integrates the user parameters with data from Tactical Decision Aids, doctrinal rules, and terrain data, and generates the AA on a map overlay.

SMI Evaluation

The purpose of this report is to document an early evaluation of the ALBM ATD SMI as part of ongoing life-cycle evaluations (Riedel & Pitz, 1986). Early evaluations are an important part of ongoing life cycle evaluations because problems can be identified while changes are still easy to make. Because the human-computer interface is considered to be one of the most critical design elements of a system (Avery, Badalamente, Bowser, O'Mara, & Reynolds, 1990), it is an important part of early evaluations. Early SMI evaluations can help to avoid the problems associated with poor interface design. Poorly designed SMIs lead to reductions in efficiency, increases in training time, and problems with user acceptance of the aid.

In general, assessments of military system interfaces involve evaluating compliance to specific military specifications and design guidelines (e.g., MIL-STD-1472D). However, the ALBM ATD system represents a technology demonstration, and does not require adherence to specific military standards and specifications. The main guidance for interface development of the ALBM ATD system was the Open Software Foundation (OSF) Motif

Style Guide (i.e., a set of standard guidelines for the development of industrial software interfaces) - with no formal evaluation of the interface required. Therefore, it was decided to conduct a formal evaluation of the ALBM ATD SMI by examining how well it meets the principles and guidelines of good interface design.

The method chosen was an evaluation of compliance to several sources of interface design guidelines and principles, both military and non-military in origin. Design guidelines are important because they (1) serve as an aid to develop usable display screens and interactive procedures, (2) ensure consistency of design by providing a common approach, and (3) reduce the personnel selection burden by reducing training time and possibly manpower requirements for the system (Department of Defense Human-Computer Interface Style Guide - Version 2.0, 1992).

The guidelines used were the Department of Defense (DOD) Human-Computer Interface Style Guide - Version 2.0 (Avery & Bowser, 1992), Smith & Mosier's Guidelines for Designing User Software (1986), Human Factors Design Guidelines for the Army Tactical Command and Control (ATCCS) Soldier-Machine (Avery et al., 1990), and the Army's MIL-STD-1472D (1989). From these guidelines, a questionnaire was developed to assess how well the SMI followed the guidelines and principles of good interface design. A questionnaire approach was chosen because it is fast, economical, and has been used successfully to evaluate interfaces in previous projects.

Method

Development of the Assessment Instrument

The first step in evaluating the ALBM ATD SMI was to become familiar with the system. Familiarization began by reviewing system documentation and design requirements materials (e.g., Functional Description Requirements Specifications or FDRS, Detailed Design Review Packages for specific tools) with special attention given to requirements related to the development of the SMI. Next, a demonstration of the system capabilities was observed. The demonstration included an overview of the capabilities of the ALBM ATD tools, examination of the top- and intermediate-level menus, and a brief look at examples of the types of map displays and overlays. In addition, an AA was generated with the AA Generate Tool.

The next step was to develop the assessment instrument. Because the ALBM ATD had no specific interface design requirements (e.g., MIL-STD-1472D), questions were derived from military and non-military guidelines [i.e., DOD Human-Computer Interface Style Guide - Version 2.0 (Avery & Bowser, 1992), Smith & Mosier's Guidelines for Designing User Interface Software (1986), Human Factors Design Guidelines for the Army Tactical Command and Control (ATCCS) Soldier-Machine Interface (1990), and MIL-STD-1472D (1989)]. Examples of assessment questions are shown in Table 1.

From the sources described above, a data base of 287 potential questions was developed based on the characteristics of the ALBM ATD system. The questions ranged from general to specific. For example, the ALBM ATD system is graphically driven with emphasis on interaction with map overlays and displays, with little direct data entry or data editing required. Therefore, there were more in-depth questions assessing the Map and Situation Display Graphics capabilities of the system than for its Data Entry and Data Editing capabilities. The data base of questions is given in Appendix A.

An additional feature of the question data base is that each question can be traced backed to the source document (e.g., DOD Human-Computer Interface Style Guide - Version 2.0, Smith & Mosier's Guidelines for Designing User Interface Software). Following each question, its source document and location in the source is identified (e.g., Is an escape or exit function provided to easily abort a function or operation? DOD 8.3.1.14c). The questions were mapped first to the DOD Human-Computer Interface Style Guide - Version 2.0 (Avery & Bowser, 1992) followed by the Human Factors Design Guidelines for the ATCCS Soldier-Machine Interface (Avery et al., 1990), Smith & Mosier's Guidelines for Designing User Interface Software (1986), and MIL-STD-1472D (1989). However, most of the questions can be mapped to more than one source document.

Table 1

Examples of Questions in the Data Base

Is an escape or exit function provided to easily abort a function or action?
Is an interrupt command available to return system control to the user if the system locks up?
When large geographic areas are displayed, is the earth's curvature consistently projected?
Are map labels legible at all display resolutions?
Are function key labels distinctive and easily understood by the user?
Can windows be resized, moved, or overlaid?

Table 2 shows the 13 general question areas related to interface design, relevant sub-areas, and the number of questions in each area. The 13 general question areas are:

- Interactive Control Actions (how interaction between user and computer is performed),
- Data Entry (user actions involving input to the computer, and computer responses to those inputs),
- Screen Design (how information is arrayed and presented on display screens) and Data Display (how text, presentation graphics, and tables are displayed to the user),
- Data Protection (how the computer responds to potential data loss from user errors),
- Form Filling (how users perform sets of related "fill-in" options, and how the computer responds to such inputs),
- Map and Situation Displays (how data is presented in graphical formats to users),
- Direct Manipulation (how users control the interface by acting directly on objects on the screen)
- Workstation Resources and Utilities (how users access workstation resources and utilities),
- Windows (visual representation of how users interact with an applications program, allowing users to "see" into application),

Table 2

Design Guidelines Contained the Question Data Base

- Interactive Control Actions (34)
  - General (5)
  - Sequence Control (3)
  - Interrupts (2)
  - Cursor (5)
  - Feedback (4)
  - Error Feedback (5)
  - Error Management (7)
  - Response Time (1)
  - System Status (2)
- Data Entry (10)
  - General (5)
  - Text Editing (5)
- Screen Design and Data Display (48)
  - General Screen Design (11)
  - Screen Design Format (3)
  - Screen Design Organization (7)
  - Screen Design Column Displays (4)
  - Data Display General (7)
  - Data Display Control and Editing (5)
  - Data Display Forms/Layout (3)
  - Data Display/Presentation Graphics (6)
  - Data Display/Tables (2)
- Data Protection (12)
  - General (4)
  - User ID (3)
  - Data Access (2)
  - Data Transmission (2)
  - Design Change (1)
- Form Filling (13)
- Map and Situation Graphics (47)
  - General (19)
  - Pan & Zoom Functions (13)
  - Display Sequencing (6)
  - Editing (4)
  - Standard Symbols and Graphics Library (5)
- Direct Manipulation (4)
- Workstation Utilities (1)
- Icon Usage (13)
- Windows (22)

(Table 2 Continued)

Menus (29) General (13) Format (4) Menu Bars (2) Pull Down and Pop-up Menus (3) Hierarchial Menus (7) Table Function Keys (10) (19) Color Usage (23)

- Menus (how users perform selection of options, and how the computer responds to such selections),
- Function Keys (how users perform control entries by direct selection of labeled keys),
- User Help (messages, labels, and prompts used to inform and instruct users), and
- Color Usage (how color is used to discriminate information presented in the interface).

For the last step, questions were selected from the data base and put into a rating scale format. Question selection was based on the following issues. As explained earlier, the number and level of detail for each area was determined by the system's capabilities. Second, certain question areas were shortened or omitted entirely because the system did not possess the capability at all or the capability was not fully developed. For example, the current ALBM ATD system provides no function keys. Therefore, no questions on function keys were included in the assessment.

Third, questions were selected to address the interface requirements from the FDRS (e.g., the SMI must be transparent to user, the SMI must immediately display the consequences of user actions upon current active foreground, the SMI must be customizable to individual user needs, incorrect or unavailable user choices shall be unavailable to user - limiting erroneous input, undo facilities must be provided - user will be notified of irreconcilable actions, user should be able to correct input errors and to recover processing capabilities from input errors) [ALBM ATD FDRS, 1992].

Finally, the number and depth of the questions depended on whether the area had been evaluated previously by a "quick look" evaluation of Version 1.0 of the software. The "quick look"

consisted of a brief, cursory examination of the previous software version to identify particular problems (e.g., when a subordinate window was opened, it often appeared under the main window). If the problems in certain areas had been highlighted by the "quick-look" evaluation, questions related to that problem were reduced or omitted. Conversely, if the quick-look did not cover a particular area, the number of questions in that area was increased.

A simple 4-point rating scale was used for the questions (see Figure 1). The anchors were 1 = Always, 2 = Mostly, 3 = Sometimes, and 4 = Never. A "Not Applicable" response was included as "5." The questions were presented in a tabular format, and a comments area was provided for each question. The Interface Assessment Instrument appears in Appendix B.

As seen in Appendix A, the Interface Assessment Instrument had 152 questions from the following areas: (1) Interactive Control Actions, (2) Data Entry, (3) Screen Design and Data Display, (4) Data Protection, (5) Form Filling, (6) Map and Situation Graphics, (7) Icon Usage, (8) Windows, (9) Menus, (10) User Guidance, and (11) Color Usage.

Data Collection

A human factors specialist (the first author) viewed a detailed demonstration of the prototype and evaluated the interface using the Interface Assessment Instrument.

ALBM Interface Assessment

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Interactive Control Actions General Is an escape or exit function provided to easily abort a function or operation?						
Can the information in the screen display be customized by the user (e.g., defining files that are to be displayed concurrently)?						
Are control actions simple (completed with a minimum number of actions)?						
Sequence Control Are control actions performed consistently throughout the system (e.g., enter functions the same from one task to another)?						
Are step-by-step actions permitted for beginners?						
Are more complex command entries permitted for experienced users?						

Figure 1. Format of interface assessment instrument.

Results

The results presented and discussed here are organized into a number of sub-sections. First overall results are presented and discussed; next results and discussions are presented of evaluations of 13 specific interface areas.

Overall Findings

In general, the results revealed that the main problems with the ALBM ATD SMI stemmed from inconsistent application of the principles and guidelines for good interface design. These inconsistencies were prevalent in the areas of interactive control actions, screen design, data protection, and user guidance. For example, in some displays several interactive control actions or steps were required to execute an action, whereas in other displays, interactive control actions were simple, and executed with few actions. In another example, in some terrain overlays, a color legend was provided to explain colors displayed on the screen. However, in other terrain overlays, there was no color legend provided. There were even some instances in which design principles or guidelines were not applied at all (e.g., cancel or interrupt actions were virtually non-existent, the only abort control action is in the AA Generate Tool).

Interactive Control Actions

There were only three instances of guidelines for interactive control actions being applied consistently throughout the interface. Specifically, a cursor action resulted in entry of items regardless of cursor position, moving or resizing windows was indicated by a change in cursor shape, and corrections were easily made to data entry errors.

As seen in Table 3, most of the interactive control actions needed for good interface design were applied inconsistently throughout the interface. For example, step by step actions were given only in the Smart Palette function of the Overlay Editor. The following interactive control actions were not used consistently throughout the interface:

- sequence control actions (e.g., control actions are performed inconsistently, step by step actions are not always given for beginners, complex command entries are not always permitted for experienced users),

Table 3

Rating Results for Interactive Control Actions

Interactive Control Actions	Always	Mostly	Sometimes	Never	Not Applicable
General Escape or exit function is provided				X	
Information in the screen can be customized by user				X	
Control actions are simple			X		
Sequence Control Control actions are performed consistently			X		
Step by step actions are permitted for beginners			X		
Complex command entries are permitted for experienced users			X		
Interrupts Cancel option is provided for just made changes				X	
Interrupt command is available if system locks up				X	
Cursor Enter action results in entry of items regardless of cursor position	X				
Movement or resizing of window is indicated by change in cursor shape	X				
Cursor is placed at first option at the appearance of each page or frame			X		
Feedback All inputs produce a perceptible system response			X		
Transaction status is indicated during lengthy transactions			X		
System indicates completion of lengthy transactions			X		
Error Feedback Constructive error messages are provided for entry errors			X		
Error messages are specific enough			X		

Table 3

Rating Results for Interactive Control Actions (continued)

Interactive Control Actions	Always	Mostly	Sometimes	Never	Not Applicable
Error Management User confirmation of entries that destroy/alter data are required			X		
Warning is given of potential data loss			X		
User is requested to confirm quit, save data files, or cancel to prevent data loss at log off			X		
Data files are saved automatically at log off				X	
User input is limited to appropriate input areas			X		
Undo facilities are provided for user selected operations				X	
Corrections are made easily to data entry errors	X				
System Status Indication of system status is provided at all times			X		

- feedback responses (e.g., all inputs did not produce a perceptible system response, transaction status is not always indicated during lengthy transactions and the system does not always indicate completion of the transaction),

- error feedback (e.g., constructive error messages were not always provided, many error messages were not specific),

- error management (e.g., user confirmation of entries that would possibly destroy or alter data are not always required), and

- system status responses (i.e., indication of system status was not always provided).

Finally, there were some guidelines for interactive control actions that were never applied to the interface. The guidelines are:

- an escape or exit function from processing should be provided,

- information on the screen should be customizable by the user,

- there should be a cancel option for just made changes,

- there should be an interrupt command available for system lock-ups,

- data files should be automatically saved at log-off, and

- undo facilities should be provided for user selected options.

Data Entry

Unlike interactive control actions, most of the data entry actions needed for good interface design were applied consistently throughout the interface. In general, data entry and text editing functions (e.g., selecting and editing text) were easily accomplished. However, in the Document Browser Tool, the "undo" button did not work making it difficult to reverse editing actions. It should be noted that the limited exposure to the system made it difficult to determine whether the most frequent actions were the easiest to accomplish (see Table 4).

Screen Design and Data Display

Screen Design. Most of the screen design guidelines were applied inconsistently throughout the interface (see Table 5). Only the guidelines for column displays (e.g., line length for text columns was restricted, alphanumeric columns were left

Table 4

Rating Results for Data Entry

Data Entry	Always	Mostly	Sometimes	Never	Not Applicable
General The most frequent actions are the easiest to accomplish					X
Data entry is designed so that it is easily accomplished	X				
Text Editing Words, sentences, or paragraphs can be copied in block form	X				
Words, sentences, or paragraphs can be moved in block form	X				
Selecting and editing text is accomplished with minimum difficulty and text changes are displayed immediately	X				
Text actions are reversible			X		

Table 5

Rating Results for Screen Design and Data Display

Screen Design and Data Display	Always	Mostly	Sometimes	Never	Not Applicable
Screen Design - General Information is provided on the screen in a usable format			X		
Headers and other invariant fields are placed consistently from screen to screen			X		
Functional fields are provided for messages and alarms				X	
Multiple pages are used for displays with too much data					X
Different elements in the display format are easily distinguished			X		
Abbreviations conform to accepted standards and conventions	X				
Titles are provided at the top of every page describing screen			X		
Status and error messages, prompts, and command entry areas are located at the bottom of screens				X	
Large portions of text are broken into small groups or columns to improve readability			X		
Column Displays Alphanumeric columns are left justified for rapid scanning	X				
The line length in text columns is restricted (no more than 35-40 characters)	X				
Data Display - General Text is displayed in conventional use of mixed upper and lower case	X				
Conventional rules of punctuation are used	X				
The display uses simple sentence structure	X				
The system allows paging and scrolling		X			
Labels of fields infer the data content of that field			X		
Presentation Graphics Data-driven graphics (e.g., pie and bar charts) can be accomplished					X
A variety of graphic attributes (e.g., color, shading) can be accomplished					X
The graphic scale is indicated when a display is shrunk or expanded					X

Table 5

Rating Results for Screen Design and Data Display (continued)

Screen Design and Data Display	Always	Mostly	Sometimes	Never	Not Applicable
Data Display - Presentation Graphics (continued) The graphic can be displayed exactly as it will be printed					X
Tables Tabular data is organized in a recognizable fashion	X				

justified) and abbreviations were being applied consistently. Inconsistent application of screen design guidelines included:

- information was not always provided on the screen in a usable format (e.g., terrain overlays have too much data and lack color legends),
- headers and invariant fields are not placed consistently from screen to screen (e.g., the placement of "exit" and "OK" buttons varies),
- it is often difficult to distinguish different elements in the display format,
- titles provided at the top of the page are not always descriptive of its content (e.g., some window titles are programmer's file names in the AA Comparison Tool), and
- large portions of text are sometimes broken into small groups or columns.

In addition, there were no functional fields for messages and alarms located anywhere on the screens. This was probably due to the overall lack of error messages available for the entire system. Finally, multiple pages were not used for displays with too much data, instead users scrolled up and down lengthy displays.

Data Display. For the most part, the general guidelines for data display were applied consistently throughout the interface. Specifically, text was displayed in a conventional mix of upper and lower case, conventional rules of punctuation were used, simple sentence structure was used, and scrolling of text was available. However, labels of fields did not always indicate the data content of that field (e.g., it was difficult to figure out what some of the labels in the Edit Attributes of the Smart Palette function referred to). Data presented in tables was organized into a recognizable fashion, but there were no presentation graphics capabilities (i.e., creating charts, figures) available for evaluation with the current software.

Data Protection

One of the most prevalent problems with the ALBM ATO interface was that it lacked adequate data protection. The system rarely confirmed data file deletions or gross changes in the data, and there was no back-up of data performed to minimize data loss from hardware or software failure. Unfortunately, it was not uncommon for the entire system to lock-up during operation. As a consequence, the system would have to be restarted and all data from the previous session was lost (see Table 6).

Table 6

Rating Results for Data Protection

Data Protection	Always	Mostly	Sometimes	Never	Not Applicable
Periodic back-up of data is performed to minimize data loss				X	
The system requires confirmation of data file deletions or gross changes in data			X		

Form Filling

In form filling, the guidelines were being applied consistently throughout the interface (see Table 7). Data entry fields were grouped and organized logically, character and field errors were easily corrected, cursor movement was restricted to data entry fields, and the cursor was moved easily from one area to another with the mouse. However, in instances where a form required a lot of data entry, performance would be improved if the tab key could be used to move the cursor from field to field. At present, tabbing was observed in the "Edit Attributes" of the Smart Palette function only.

Map and Situation Graphics

General. For the most part, the general guidelines for good interface design were applied consistently in map and situation graphics (see Table 8). The general guidelines applied were:

- situation displays were presented as overlays on related map backgrounds,
- map labels were placed consistently,
- a consistent map orientation was used,
- map areas of special interest were defined (e.g. by use of color, texture),
- critical features were presented,
- standard military symbols were generally used (except that it was noted that there were no arrowheads on avenues of approach),
- map symbols were mostly presented in a non-overlapping fashion where possible, (except that there was no "de-cluttering capability), and
- the distance between two points was determined easily.

In contrast, significant features of maps were not always labeled in a manner that avoided cluttering the display, and map labels were not legible at all display resolutions. For example, an attempt was made to enlarge a hard-to-read label using the magnify function. As a result, the label was magnified to a pixel level, and could not be read at all.

Panning and zooming capabilities. Panning and zooming were accomplished with a special function referred to as the "spider." Use of the "spider" revealed that there were major problems in panning and zooming the map displays, and few of the guidelines for good design were met. Although panning incorporated all aspects of the graphic, the display areas were not easily changed and there was no indicator showing the location of the panned.

Table 7

Rating Results for Form Filling

Form Filling	Always	Mostly	Sometimes	Never	Not Applicable
Data entry fields are grouped and organized logically to facilitate performance of task		X			
There is easy error correction for characters and fields	X				
The movement of the cursor is restricted to data entry areas during form filling	X				
The cursor can be moved easily from one area to another	X				

Table 8

Rating Results for Map and Situation Graphics

Map and Situation Displays	Always	Mostly	Sometimes	Never	Not Applicable
General The earth's curvature is consistently projected in displays of large geographic areas					X
Situation displays are presented as overlays on related map backgrounds	X				
Map labels are placed consistently		X			
Significant features of maps are labeled without cluttering display			X		
A consistent map orientation is used throughout system	X				
Map areas of special interest are defined by use of color, shading, texture patterns, or highlighting	X				
All critical features are represented in the map		X			
Map labels are legible at all display resolutions			X		
Symbols are placed on the map accurately or are connected to location using pointers (e.g., lines, arrows)	X				
Are standard military symbols used		X			
Are map symbols presented in a non-overlapping manner where possible		X			
When a portion of a map is displayed, a map inset is used to show the displayed area's location within the larger map					X
The distance between points can be determined easily	X				
The bearing between points can be determined easily					X
The animation of graphics can be displayed smoothly					X
Pan and Zoom Functions *Panning incorporates all aspects of the graphic*	X				
The displayed area can be changed easily when panning				X	
An indicator is used to show where the area being panned in located in the overall display				X	
The user can easily return to the starting point during panning			X		

Table 8

Rating Results for Map and Situation Graphics (continued)

Map and Situation Displays	Always	Mostly	Sometimes	Never	Not Applicable
Pan and Zoom (continued) Zooming reveals fine details of the graphic			X		
The user can easily return to the normal display size when zooming	X				
An indicator is provided showing the amount of change in the display when zooming				X	
An indicator is used to show where the area being zoomed is located in the overall display				X	
The user can control how often displays are updated					X
The display can be frozen to prevent further updates					X
Display Sequencing Display sequencing allows selective presentation and removal of displayed data					X
Display sequencing shows temporal changes in the data base					X
The rate of display sequencing can be controlled by the user					X
Display sequencing can be paused or suspended					X
An indicator is provided to show status of sequencing operations					X
Display sequencing is presented in forward and reverse order					X
Editing The user can return easily to a selected display within a sequence of displays					X
Symbols, labels, or other features can be added or deleted without destroying background information	X				
The user can expand display areas for placement of critical information	X				
Selected elements of a display can be deleted, and the deletions can be restored	X		X		

Table 8

Rating Results for Map and Situation Graphics (continued)

Map and Situation Displays	Always	Mostly	Sometimes	Never	Not Applicable
Standard Symbols and Graphics Library A library of standard symbols and map graphics are provided	X				
Symbols and map graphics are easily labeled			X		
New symbols and graphic overlays can be created				X	
Symbols and graphic overlays can be edited	X				
A new library of symbols and map graphics can be created			X		

area on the overlay. Returning to the starting point during panning operations was often difficult, and seemed to be a function of guesswork.

In zooming, it was easy to return to the normal display size using a button on the "spider". However, the fine details of a graphic were not always revealed because there was a limited degree of resolution available. In addition, there was no indication of where the zoomed area was located on the overlay, and no indication of the amount of change in the display when zooming.

Editing capabilities; standard symbols and graphics library. In editing the displays and overlays, symbols or other features were added or deleted without destroying background information. Display areas could be expanded for the placement of critical information. Although selected elements of a display could be deleted and restored, it was not a simple operation. To delete an element, it had to be cut with the overlay editor function and the display had to be saved. To delete and restore an element, it had to be "hidden" and restored.

Standard symbols and graphics were provided in a library, and it was possible to edit them. However, the symbols and graphics were not always easily labeled. It was possible to change existing labels (e.g., phase lines) through the edit attributes function, but new labels, symbols, and graphics could not be created with the free draw function. It was also difficult to create a new library of symbols and graphics.

Display sequencing. All of the map overlays and displays were static in the current software. Therefore it was not possible to evaluate the system's display sequencing capabilities.

Direct Manipulation and Workstation Utilities

For the most part, the dialog type was matched to the task at hand (see Table 9). However, there were areas in the interface in which function keys or accelerator keys could facilitate performance. For example, a function key (e.g., F1) could be used for help or experienced users could bypass the often lengthy menu structure of some tools with accelerator keys. In addition, it would be more advantageous for the user to be able to tab through some of the menus instead of always having to use the mouse.

In addition, the guidelines for workstation utilities were not followed consistently (see Table 9). Although there was access to some utilities (e.g., clocks, calculator) and a print screen capability was present, the interface could not be customized by the user.

Table 9

Rating Results for Direct Manipulation and Workstation Utilities

Direct Manipulation and Workstation Utilities	Always	Mostly	Sometimes	Never	Not Applicable
Direct Manipulation The dialog type seems appropriately matched for the task at hand		X			
Workstation Utilities Workstation utilities are provided to the user			X		
A screen saver is activated if the terminal is idle, and can be deactivated by user action	X				
The user is allowed to arrange windows and icons on the screen to meet individual task demands				X	

Icon Usage

There were only a few icons used in the current interface, and they appeared in the Plans Folder. Therefore, it was not possible to conduct a comprehensive evaluation of icon usage. However, the Plans Folder icons did have appropriate labels placed beneath them, and were highlighted when selected (see Table 10).

Most guidelines for good interface design were applied consistently in windows applications (see Table 11). Essentially, windows could be displayed concurrently, resized, moved, or overlaid. In addition, the resize border was removed from static windows, the active window was designated by a color change, all window titles were located at the top, scrolling actions were easily accomplished, and closing a temporary window did not remove information in the active window. It should be noted that there was not enough time to determine whether dialog boxes were used consistently throughout the system.

In some instances, however, the guidelines were not applied consistently. Many identifying labels did not describe the window's contents and the titles of subordinate windows did not always match menu selection titles of superordinate windows. In addition, the entire window contents did not always remain visible during resizing (e.g., a few windows lost their scroll bars when they were reduced in size) and subordinate windows and dialog boxes did not always close automatically if the main applications window was closed (e.g., closing the "Combat Effectiveness" window did not automatically close the "Task Organization subordinate window). Finally, the area provided for data entry, commands, and prompts was not always located at the bottom of the display (e.g., the button for "apply" was located at the top of the display in the "Edit Attributes" window).

Menus

General. There were several general menu guidelines that were always/mostly applied throughout the interface (see Table 12). Those guidelines are as follows.

- Immediate feedback was always given when an item was selected.
- Most lists of menu and sub-menu items were brief (except it was noted that some menus exceeded 5-7 options such as the "Tools" button on the main menu bar).
- Most unavailable options were not displayed (except in the AA Generation Tool where the "Avoid NO-GO Areas" button was not disabled).

Table 10

Rating Results for Icon Usage

Icon Usage	Always	Mostly	Sometimes	Never	Not Applicable
The icon represents its function appropriately					X
The meaning of icons is consistent across all displays					X
Labels are provided for icons that distinguish their precise function					X
Icon labels are placed beneath the icon	X				
Icons are highlighted when selected	X				

Table 11

Rating Results for Windows

Windows	Always	Mostly	Sometimes	Never	Not Applicable
General Several windows can be displayed concurrently	X				
Windows can be resized, moved, or overlaid	X				
The contents of a window remain visible during resizing		X			
The active window is indicated when several windows are displayed	X				
The user can easily shift from one window to another	X				
The screen background provides a neutral pattern for overlapping windows	X				
The resize border is removed from static windows	X				
Scrolling actions inside windows are easily accomplished		X			
All windows have identifying labels that describe window contents			X		
All window titles are located at the top of windows	X				
Titles of subordinate windows match menu selection titles of the superordinate window			X		
If a temporary window is opened, the information in the active window is restored after removal of the window overlay	X				
The area provided for commands, data entry, and prompts is placed at the bottom of the display			X		
Dialog boxes are used consistently throughout the system					X
All subordinate windows and dialog boxes close automatically if the main applications window is closed		X			

Table 12

Rating Results for Menus

Menus	Always	Mostly	Sometimes	Never	Not Applicable
General Menu instructions and error messages are placed in the same position for every menu					X
Immediate feedback is given when a menu item is selected	X				
Menu functions are grouped in terms of logical function, frequency, or criticality of use			X		
Menus can be reached di. ctly by command without going through sequence of menus				X	
The number of menu responses is minimized to reduce selection times			X		
Two modes are provided to make menu selections			X		
Lists of menu and submenu items are brief (e.g., 5-7 options)		X			
Only those options available for a transaction are displayed		X			
The location of pop-up menus is tied to the position of the cursor and pop-up near the menu or item being manipulated		X			
The selected option from a pop-up menu remains highlighted					X
Hierarchial Menus Main and sub-menus are arranged in a hierarchial order	X				
Hierarchic menus are displayed in a consistent manner					X
The hierarchial menus are easily navigated	X				
The hierarchic structure is designed to minimize the number of menus traversed (e.g., uses a broad, shallow menu tree)			X		

- The location of pop-up menus is generally tied to the position of the cursor. (It was noted in one instance that the location of the pop-up menu was tied to the position of the last pop-up menu.)

Yet, other general menu guidelines were not applied consistently. For example, menu functions were not always grouped logically, the number of menu responses was not always limited to reduce selection times, and two modes of menu selection were available from selected menus only. There was one instance in which a guideline was never followed; no menus could be reached without going through a sequence of menus (e.g., with accelerator keys). Finally, because there were so few menu instructions used, their placement in the menu could not be determined. It could also not be determined whether selected options in all pop-up menus were highlighted in the time available for the evaluation.

Hierarchial menus. It appeared that the most of the guidelines for hierarchial menus were applied consistently throughout the interface. Main menus and sub-menus were generally arranged in hierarchial order and were easily navigated. However, in many places the hierarchic structure was multi-level and did not minimize the number of menus traversed. For example, five levels of menus and several layers of windows had to be traversed to reach some map overlays in the system. Due to time constraints, it was not possible to assess whether all hierarchic menus were displayed consistently.

User Guidance

As seen in Table 13, user guidance was another problem area in the design of the ALBM ATD interface. Most of the on-line help was incomplete and lacked the level of detail needed to effectively aid in the use of the system. Consequently, the majority of the guidelines for help design were applied inconsistently throughout the interface. For example, help was not available from every screen, help aids were not consistent from screen to screen (e.g., the placement of help buttons varied), and successively detailed explanations of error messages were rarely provided (i.e., they were found only in the AA Generation Tool). Prompts for guidance and basic information were also rare. In addition, there was no single action or keystroke access to and exit from help (e.g., a function key), and it was not possible for the user to request help on a particular item. Unfortunately, there was simply not enough detailed help available to determine whether help was tailored to experienced users; whether error messages were clear, concise, and appropriate to the user; or whether the user was shown how to navigate through help.

Color Usage

Overall, the design guidelines for color usage were applied throughout the interface (see Table 14). Color coding was based

Table 13

Rating Results for User Guidance

User Guidance	Always	Mostly	Sometimes	Never	Not Applicable
On-line help is available from every screen			X		
There is a single stroke access to and exit from help				X	
Beginners can request prompts for guidance and basic information			X		
The item about which help is being requested can be specified by the user				X	
An experienced user can get help in selected areas, information on short-cuts, system limitations					X
Help aids are consistent from screen to screen			X		
Error and help messages are clear, concise, and appropriate to the user					X
The user is shown how to navigate through help					X
Successively more detailed explanations of error messages are provided			X		

Table 14

Rating Results for Color Usage

Color Usage	Always	Mostly	Sometimes	Never	Not Applicable
The color coding enhances, not reduces, screen readability			X		
Color is used consistently from screen to screen			X		
The color of a label is consistent with its meaning (red - enemy)					X
Color coding is based on conventional associations with particular colors (e.g., green for go)		X			
A conservative number of colors is used for coding			X		
Highly saturated colors are avoided when employing color pairings		X			
Contrasting colors are used to emphasize different tactical information		X			
Similar items are coded with similar colors (e.g., yellow and orange)					X
There is a high contrast between foreground and background displays	X				
White is used to highlight data	X				
Colors are used consistent with their associated meanings (e.g., red for alert, critical information, enemy designation)	X				
In map graphics, color codings of texture patterns or variations in tone are ordered so that the darkest and lightest shades correspond to extreme values of the variable					X

on conventional associations with particular colors except in one instance where a "no action" button on the "Grid Spacing Configuration" screen was colored green. Contrasting colors were used to emphasize different information and pairings of highly saturated colors were mostly avoided, except in the "Elevation Color Configuration" overlay where magenta, yellow, and green were used to denote differing elevations. There was also a high contrast between foreground and background displays, white was used to highlight data, and colors were used consistently with associated meanings (e.g., red for alert, enemy; blue for friendly).

There were some color guidelines that were not followed throughout the interface. Sometimes, color coding reduced screen readability (e.g., some shades of green used for a button made it difficult to read its white label), and color usage was not consistent from screen to screen (e.g., colors choices varied in the terrain feature overlays). In addition, the number of colors used for coding in the map overlays exceeded the recommended numbers. Often, there were no color legends available to explain what the colors referred to (e.g., in the "Elevation Color Configuration" overlay). Finally, due to time limitations, it was not possible to determine whether variations in tone were ordered from darkest to lightest, whether similar items were coded with similar colors, or whether a label's color was consistent with its meaning throughout the system.

Conclusions and Recommendations

Overall Conclusions

The results revealed that the deficiencies noted in the ALBM ATD SMI were due to the inconsistent application of the principles and guidelines for good interface design. In other words, principles for good interface design were being applied in some functions or screens, but not in others.

Although inconsistencies were noted in every area evaluated, they were prevalent in the areas of interactive control actions, screen design, data protection, and user guidance. In addition, the results showed that some ALBM ATD capabilities could not be evaluated because they were not currently available (e.g., user guidance, display sequencing).

Adherence to DOD Human-Computer Interface Style Guide--Version 2.0

The purpose of the DOD Human-Computer Interface Style Guide is to achieve standardization of graphic user interfaces (GUIs). The present evaluation was not designed to specifically compare the ALBM ATD SMI to the DOD Human-Computer Interface Style Guide. However, it was possible to see how well the ALBM ATD SMI generally met applicable parts of the DOD Style Guide framework for human-computer interface design and implementation.

Screen design. In general, the ALBM ATD SMI did not meet the DOD Style Guide for Screen Design. First, the ALBM ATD did not meet the guidelines for Initial Screen Design (i.e., Workstation Utilities) because it did not provide a true workstation for users. For example, access was provided to some workstation utilities, but the user could not customize the interface, and printing capabilities were limited to screen prints.

For General Screen Design, the guidelines were inconsistently applied throughout the interface. For example, information was not always provided on the screens in a usable format, and there were problems with consistency (e.g., headers, invariant fields, and button placement varied from screen to screen). Third, screen format guidelines were not always applied. With respect to screen organization, headers and titles were provided for every display, but they did not always describe the contents or purpose of the display. There were also no areas on the displays for functional fields or error messages. Fourth, the ALBM ATD SMI did not provide multiple screens or pages for displays with too much data. Instead, the user had to continuously scroll through these displays. However, it appeared that the ALBM ATD SMI did adhere to general guidelines for data organization (e.g., large portions of text were generally broken into smaller portions, column displays restricted line length, alphanumeric columns were left justified).

Color Usage. With respect to color usage, it appeared that the ALBM ATD relied too heavily on color coding especially in the maps and overlays. As pointed out in the DOD Style Guide, color coding should be used only after the displays have been designed for effective use in an achromatic format because users with defective color vision would have difficulty discriminating among the colors. Despite this, the ALBM ATD did generally adhere to color guidelines (e.g., colors were used consistent with their associated meanings and white was used to highlight data). However, there were problems in that there were no color legends supplied for many displays, colors were not used consistently from screen to screen, and too many colors were used in some displays.

Windows. In contrast to Screen Design, the ALBM ATD did meet most of the guidelines for windows. For example, most of the guidelines for basic window appearance were met (e.g., title bars were used appropriately, windows could be reduced to icons). However, many titles did not describe the window's contents, titles of subordinate windows did not always match the main window, and the entire window contents did not always remain visible during resizing. In addition, windows could only be controlled through the mouse; there was no way to access controls through the keyboard.

In general, the ALBM ATD followed the guidelines for window design (e.g., more than one line of data could be displayed, a neutral background was used for overlapping windows) and window controls (e.g., windows could be moved or resized easily, scrolling was easily accomplished). The guidelines for window designation were also generally met (e.g., the active window was designated by a color change, shifting from one window to another was easily accomplished). However, the ALBM ATD SMI did not provide users with any sort of iconic or text map/indication of all open windows.

Menus. As with windows, the ALBM ATD met most of the general DOD Style guide for menus. Specifically, immediate feedback of selection was given, most lists of menu items were brief, most unavailable menu options were not displayed, and hierarchial menus were used appropriately. However, many of the guidelines for menu format were not met (e.g., menu functions were not always grouped logically, menu responses were not always limited to reduce system response times). Overall, navigating the menu structure was easily accomplished, but in some places the hierarchic menu structure was too complex for efficient navigation (e.g., several layers of menus and windows had to be traversed before reaching some map displays). Finally, there was limited access to menu options through the keyboard.

Object Orientation. With respect to icon usage, it was not possible to evaluate the ALBM ATD SMI because so few icons were used in the system (i.e., icons were present only in the Plans Folder).

On-line Help. The on-line help facilities of the ALBM ATD SMI did not meet the DOD Style guidelines because they were incomplete and lacked the level of detail needed to effectively aid users. For example, help was not always easy to access, it was not available from every screen, there were not enough prompts for guidance and basic information, and users could not request help on individual items.

Interactive Control. Interactive control was another area of the ALBM ATD SMI that did not meet DOD Style guidelines. In general, there were problems with consistency (e.g., control actions were not performed consistently, "exit" and "close" were used interchangeably for exiting windows, control actions were simple for some displays and complicated for others), control (e.g., there were few escape or exit options available if system lock-up occurred), and response time (e.g., some processes took over 10 minutes to complete, and the user could not go on to other tasks during lengthy system processing).

Feedback. The interface did not meet the guidelines for feedback. For example, all inputs did not produce a perceptible response from the system, transaction status was not always indicated, and the system did not always indicate completion of transactions). There were also very few instances where interrupts were provided (e.g., there were no pause and continue options, only one abort key appeared in the entire system, and indications of system status were not always provided). Finally, error management guidelines were not met (e.g., "undo" facilities were rare, there were no explicit warnings of potential data loss).

Adherence to ATCCS Design Guidelines

As with the DOD Style guidelines, the present evaluation did not specifically compare the ALBM ATD SMI to the ATCCS Design Guidelines. However, one area of the present evaluation was developed based on the ATCCS guidelines - Maps and Situation Displays.

With respect to Maps and Situation Displays, the general ATCCS guidelines were met. For example, map labels were positioned correctly; a consistent map orientation was used; colors, shading, texture patterns, or highlighting were used to define map areas of special interest; and critical features of maps were generally presented. In addition, standard military symbols were used appropriately.

There were, however, problems with map label legibility and significant features of maps were not always labeled in a way that avoided cluttering the display. There were also no insets provided to show where the displayed portion of the map is within the larger map. Also, there were particular problems noted with the panning and zooming functions (e.g., the changing of areas being panned was not easily accomplished, there was no indicator showing where the panned area was located in the overall display,

the fine details of the graphic were not always revealed during zooming, there was no indication of where the zoomed area was located in the overall display).

In addition, there were no explicit options available for editing displays. In order to edit the displays, several operations had to be performed (e.g., cut, paste, saving the cut and past as a separate overlay). Finally, a library of graphic symbols was provided, but new symbols could not be created.

Conformance to FDRS

An examination was conducted to see how well the ALBM ATD SMI met the requirements stated in the FDRS (ALBM ATD FDRS, 1992). However, the examination was limited because parts of the software either were incomplete or non-operational.

Access to and manipulation of staff product objects or associated battlefield objects. The ALBM ATD SMI provides limited access to and manipulation of these objects. For example, creation and manipulation of staff products was difficult (e.g., it was difficult to create briefing slides through the "Briefing Support" Tool), there were no services to store, revise, or display objects on magnetic media for later retrieval and reuse, and hardcopy color printing of entire screen was possible but one could not print individual map overlays or contents of a single window. In addition, the display of user inputs was not immediate in some cases (e.g., refresh by software often exceeds reasonable limits) and users could not proceed with other requests or services while waiting for the refresh.

Robustness. The ALBM ATD SMI currently has problems with robustness. It frequently locked-up without warning or explanation, and there were no procedures built-in to recover lost data. More important, the system often crashes without warning, and a "cold" restart (i.e., shutting down all the processes and re-booting) usually has to be performed to get the machine running again.

User friendliness. The SMI was also not "user friendly." The user could not customize the interface to suit individual needs, and the SMI was not "transparent" (i.e., it could not be operated without some knowledge of the underlying operating system). There were few error management procedures available and existing procedures were not used consistently throughout the system (e.g., limited "undo" facilities available, unavailable options not always disabled, input options not always clearly labeled). Because on-line help was not fully implemented, guidance on how to operate the system was limited. Finally, there were "drag and drop" capabilities available in the map overlays via the mouse, but "drag and drop" printing or deleting capabilities were not available.

GUI requirements. The GUI requirements were not fully met by the SMI. For example, a graphical editor was provided, but

modifying attributes was often difficult (e.g., "Overlay Editor" difficult to use). User-defined graphic objects could not be easily incorporated into existing overlays because the "Free Draw" function did not work.

In addition, "what you see is what you get" editing capabilities were generally available and map graphics facilities were provided. However, the selection of map backgrounds and overlays was restricted to current capabilities (i.e., only static map overlays of one area were currently available) and pan and zoom capabilities were not easily accomplished (e.g., "Spider" was difficult to use). Free drawing of Army standard symbology was also difficult (e.g., "Free Draw" function did not work).

SMI device interaction. The requirements for SMI device interaction were not fully met by the SMI. Although the pointing device or mouse was compatible with MCS Version 11.xx requirements, concurrent use of the keyboard for commands was not available throughout the interface. Access to external tools was also limited. Specifically, some workstation utilities were available (e.g., clock, calculator, document processor) but there was no access to a spread sheet or a data base processor that edits externally generated products. Local area network (LAN) access was also not yet available.

Recommendations

Based on the results of the assessment, several recommendations are made. First, the interface deficiencies noted in the assessment should be corrected. Interface deficiencies like those found with the ALBM ATD SMI have a negative impact on system performance. Specifically, they increase user response time, errors, frustration levels, and require increased training time.

Second, a detailed examination of the system's conformance to the FDRS should be conducted when the software is fully operational. Third, human factors reviews of the interface should be continued throughout the development of the ALBM ATD. The present effort was in no way a comprehensive evaluation of the SMI because of time constraints and the fragility of the software. Therefore more detailed examinations of the SMI should be conducted, and should include examining the design (e.g., layout, information density) and the content of individual screens in each tool. Furthermore, continuous SMI evaluations will help to identify problems while corrections are easy to make.

Fourth, the software developer should be required to conduct in-house human factors reviews or quality control assessments prior to the delivery of each software version. This would help identify and correct many of the interface inconsistencies and reduce the need for so many "clean-ups" of the interface after delivery.

Finally, a set of general Human Factors guidelines for SMI development should be prepared, and these guidelines should be followed by the software developer. The guidelines would include what color pairings to avoid, standard positions recommended for button placement, and standard labels recommended for control actions. A similar approach has been suggested by Steiner (1992) to standardize the development of rapid prototype operator/maintainer interfaces. Specifically, Steiner proposes that prototype interfaces meet applicable criteria of MIL-STD-1472 and other human engineering criteria specified by contract.

Requiring that the software developer adhere to specific guidelines for SMI design and development would (1) help users learn the system faster because the number of interface problems are reduced and (2) reduce the need for so many "clean-ups" of the interface after software delivery. Standardizing the design and development of the SMI would also aid programmers in developing additional interfaces (e.g. Enemy Situation Capabilities Advisor and FITE interfaces). Programmers would not only profit from "lessons learned" in the current interface, but a consistent "look and feel" for the interfaces would be established to facilitate "carry-over" learning from one ALBM ATD module to another.

REFERENCES

AirLand Battle Management Advanced Technology Transition Demonstration Functional Description Requirements Specification (ALBM ATD FDRS)--Fourth Edition Draft. (1992). Fort Leavenworth, KS.

AMSAA. (1984). MANPRINT directive from Brig. Gen. Adsit to all Program Managers dated 17 October 1984.

Avery, L. W., Badalamente, R. V., Bowser, S. E., O'Mara, P. A., & Reynolds, S. E. (1990). Human factors guidelines for the Army Tactical Command and Control System (ATCCS) soldier-machine interface. U.S. Department of Energy Pacific Northwest Laboratory: Battelle Memorial Institute.

Avery, L. W., & Bowser, S. E. (1992). Department of Defense human-computer interface style guide. U.S. Department of Energy Pacific Northwest Laboratory: Battelle Memorial Institute.

Flanagan, J. P. (In preparation). Evaluation of ALBM ATD prototype version 1.2: Review of the Trend Analysis and Projection Tool. Research Product. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Galitz, W. O. (1989). Handbook of screen format design (3rd ed.). Wellesley, MA: QED Information Sciences, Inc.

Lockheed Austin Division. (1992). DRAFT software user's manual for the AirLand Battle Management Advanced Technology Transition Demonstration Force Level Control (ALBM ATD FLC) advisor system. Austin, TX.

McKeown, P. E. (In preparation-a). Evaluation of ALBM ATD prototype version 1.2: Knowledge base assessment of the Avenue of Approach Generation Tool. Research Product. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

McKeown, P. E. (In preparation-b). Evaluation of ALBM ATD prototype version 1.2: Knowledge base assessment of the Location Analysis Applications. Research Product. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Riedel, S. L., McKeown, P. E., Flanagan, J. P., & Adelman, L. (In preparation). Evaluation of ALBM ATD prototype version 1.2: Knowledge base assessment of the Avenue of Approach Comparison Tool. Research Product. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Riedel, S. L., & Pitz, G. F. (1986). Utilization-oriented evaluation of decision support systems. IEEE Transactions on Systems, Man, and Cybernetics, 16, 980-996.

Smith, S. L., & Mosier, J. N. (1986). Guidelines for designing user interface software. Bedford, MA: The MITRE Corporation. (DTIC No. AD-A177 198)

Steiner, B. A. (1992) Human engineering requirements for rapid prototyping of operator/maintainer interfaces: A proposed military standard. Proceedings of the Human Factors Society 36th Annual Meeting, 1096-1100.

Stewart, J. E., & Shvern, U. Lessons learned from a front-end analysis effort: The case of Pedestal-Mounted Stinger (PMS). Unpublished manuscript. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Tullis, T. S. (1981). An evaluation of alphanumeric, graphic, and color information displays. Human Factors, 23, 541-550.

U.S. Department of Defense. (1989)., Military standard: Human engineering design criteria for military systems, equipment, and facilities (MIL-STD-1472D). Washington, DC: U.S. Department of Defense.

Appendix A

Question Data Base

Interactive Control Actions

General

Can sequences of commands be keyed by stacking (e.g., continuous entry of several commands) their entry? DOD 8.3.1.11

Is a general list of control options (e.g., help, edit) provided that are always available as a consistent starting point for control entries? DOD 8.3.1.13

Is an escape or exit function provided to easily abort a function or operation? DOD 8.3.1.14c

Can the information in the screen display be customized by the user (e.g., defining files that are to be displayed concurrently)? DOD 8.3.1.9

Are control actions simple (completed with a minimum number of actions)? ATCCS 2.1.14.2

Sequence control

Are control actions performed consistently throughout the system (e.g., enter functions the same from one task to another)? DOD 8.3.1.13

Are step by step actions permitted for beginners? DOD 8.3.1.11

Are more complex command entries permitted for experienced users? DOD 8.3.1.11

Interrupts

Is a cancel option provided to remove any changes just made and restore the display to its previous state? DOD 8.3.4.9

Is an interrupt command available to return system control to the user if the system locks up? DOD 8.3.1.16c

Cursor

Is a character distinct from all others used to denote cursor position? DOD 8.3.1.18

Does an "enter" action result in entry of all items regardless of cursor position? S&M 1.1.24

Is the movement or resizing of a window indicated by a change in cursor shape? DOD 5.2.2.3b

Is the cursor placed at the first (most likely) option at the appearance of each page or frame? DOD 8.3.3.7

Are formats and control actions organized to minimized cursor movement? 1472D 5.15.1.6

Feedback

Do all inputs consistently produce a perceptible response from the system? DOD 8.3.1.15d

During lengthy transactions, is transaction status indicated? DOD 8.3.1.15c

When lengthy transactions are completed, does system indicate completion of transaction? DOD 8.3.1.15c

Is immediate feedback given for data processing control entries? ATCCS 2.1.15.2

Error Feedback

When entry errors are made, are constructive error messages provided stating what is wrong and what can be done? S&M 4.3.1

Are error messages specific enough? S&M 4.3.2

Is wording of error messages task-oriented? S&M 4.3.3

Are error messages worded in a neutral manner? S&M 4.3.6

Is a listing of all error messages and explanations provided in the system documentation? S&M 4.3.12

Error Management

Is user confirmation of entries that would destroy or alter data required? DOD 8.3.5.1

Are you warned of potential data loss? DOD 8.3.5.2

To prevent data loss at log off, are you prompted to confirm the quit, save data files, or cancel the request? DOD 4.1.3

Are data files saved automatically at log off? 1472D 5.15.1.6

Is user input limited to appropriate input areas (e.g, invalid menu choices are grayed out and disabled)? DOD 8.3.5.15

Are undo facilities provided for all user selected operations? DOD 8.3.5.10

Can corrections be made easily to data entry errors (i.e., directly to the data entry and immediately following data entry? DOD 8.3.5.8

Response time

Is the speed of computer response to user entries appropriate to the transaction involved (e.g., immediate response to menu selections and graphic interaction entries)? DOD 8.3.4.6

System status

Is some indication of system status (i.e., displayed clock, flashing cursor) provided at all times? DOD 8.3.4.6

If task performance is affected by operational load, does system indicate current system performance? S&M 4.1.7

Data Entry

General

Are your most frequent transactions the easiest to accomplish? S&M 1.0

Is data entry designed so that it is easily accomplished? S&M 1.0

Is data entry designed so that there are consistent steps or structure to the process? S&M 1.0

Are input actions and memory requirements minimized? S&M 1.0

Is automatic data editing provided wherever this is possible? S&M 1.3.2

Text Editing

Can words, sentences, or paragraphs be copied in block form? S&M 1.3.2.3

Can words, sentences, or paragraphs be moved in block form? S&M 1.3.2.3

Are you able to display full pages of text in final output form? S&M 1.3.2.7

Are you able to select and edit text with minimum difficulty and display edited text changes immediately? S&M 1.3

Are text editing actions reversible? S&M 1.3.33

Data Display

General

Is data displayed relevant to the task? S&M 2.2

Is display consistent with accepted standards and conventions? S&M 2.4

Is the display of symbols, labels, data, and wording consistent across displays? S&M 2.6

Is the format of text consistent across displays? S&M 2.7

Is the text displayed in conventional use of mixed upper and lower case? S&M 2.1.6

Are conventional rules of punctuation used? S&M 2.1.10

Does display use simple sentence structure? S&M 2.1.13

Display Control and Editing

Can data be user selected and displayed? S&M 2.7.1.1

When selected data is displayed, is it labeled appropriately? S&M 2.7.1.2

Can certain categories of data be selected and displayed? S&M 2.7.1.5

Does the system allow paging and scrolling? S&M 2.7.2.2

Does the user have control over the rate of display update, display freezing, and resumption of display update? S&M 2.7.3.5, S&M 2.7.3.8

Data Forms (Layout)

Do labels of fields infer the data content of that field? S&M 2.2.4

Is the use of labels consistent if they appear in different display forms? S&M 2.2.5

Is data format consistent across displays? S&M 2.2.11

Presentation Graphics

Can size, shape, or other modifications be accomplished? ATCCS 9.2.10

Can data-driven graphics such as pie charts and bar charts be accomplished? ATCCS 9.6

Are a variety of graphic attributes (e.g., colors, shading, texture patterns) available? S&M 1.6.12

Do similar displays maintain standard format, labeling? ATCCS 9.1.8

Is the graphic scale indicated when a display is shrunk or expanded? S&M 2.4.16

Can the graphic be displayed exactly as it will be printed? S&M 2.4.20

Tables

Is tabular data organized in a recognizable fashion? S&M 2.3.2

Is alphabetic data left justified - numeric data justified with respect to the decimal point? S&M 2.3.15 and S&M 2.3.16

Screen Design

General

Is critical information always displayed on the screen? DOD 4.2.1.1

Is the information density on the screen minimized by presenting only essential text to the user? DOD 4.2.1.2

Is information provided on the screen in a form that can be used by the user? DOD 4.2.1.4

Are display formats consistently structured? DOD 4.2.2.1

Are headers and other invariant fields placed consistently from screen to screen? DOD 4.2.2.2

Is the display input prompt placed in a standard location from screen to screen? DOD 4.2.2.3

Are functional fields provided for program messages, error messages, and alarms? DOD 4.2.3.2f

Is the data consistently grouped in some logical sequence apparent to the user (e.g., sequence of use, alphabetically, chronologically)? DOD 4.2.4.1 & 4.2.4.4

Are multiple pages used for displays with too much data? DOD 4.2.5.1

Is each multiple display page labeled to show its relation to other pages? DOD 4.2.5.3

Are capital letters used appropriately (e.g., in headlines, captions, labels)? DOD 4.2.3.5a

Format

Are different elements in the display format easily distinguished (e.g., by color coding, spacing)? DOD 4.2.3.1

Do abbreviations conform to accepted standards and conventions? DOD 4.2.3.1

Are abbreviations used consistently in screens? DOD 4.2.2.1

Organization

Is a title provided at the top of every page that describes its contents or purpose? DOD 4.2.3.2b

Are status and error messages, prompts, and command entry areas located at the bottom of screens? DOD 4.2.3.2e

For text displays, does screen density (i.e., ratio of characters to blank spaces) fall within acceptable limits (i.e., not in excess of 60% of available character spaces)? DOD 4.2.3.2d

Are large portions of text broken into small, meaningful groups or columns to improve readability? DOD 4.2.3.3a

Is adequate spacing between words and lines provided? DOD 4.2.3.3e

Are blank lines used to structure displays? DOD 4.2.3.3b

Are labels placed close enough to corresponding data fields? DOD 4.2.3.3d

Column Displays

Are alphanumeric columns left justified for rapid scanning? DOD 4.2.3.3h

Is numerical data without decimals right justified? DOD 4.2.3.3h

Is numeric data with decimal points justified by the decimal? DOD 4.2.3.3h

In text columns, is the line length restricted (i.e., no more than 35-40 characters)? DOD 4.2.3.4b

Is a screen saver activated if the terminal has been idle for at least 3 minutes, and is deactivated by a user action? DOD 4.1.1

Data Protection

General

Are warning messages of threats to security given automatically? S&M 6.2

Is periodic back-up of data performed to minimize data loss and hardware failure? S&M 6.3

Does the system require you to confirm data file deletions, or gross changes in the data? S&M 6.18

Do data protection or security measures create barriers to unauthorized users, while not hindering authorized users? S&M 6.1

User ID

If you cannot log on to the system, are you:

a. notified why?
b. notified what action to take?

1472D 5.15.1.5.2 and 5.15.1.5.3

Does the logon frame appear as soon as you connect to the system? 1472 5.15.1.5.1

When entered, is your password protected from view or decipher? S&M 6.1.5

Data Access

Is request for authorization required only once, at logon? S&M 6.2.1

Is the security classification of the data displayed prominently before data access? S&M 6.2.2

Data Transmission

Is automatic protection of transmitted data provided in the form of encryption for classified data? S&M 6.2.9

Is automatic protection of transmitted data provided in the form of parity checks or buffering to insure data integrity? S&M 6.4.1

Design Change

Is the user interface protected from any changes that might impair functions supporting data entry or display, sequence control, access to or transmission of data? S&M 6.5.2

Form Filling

Are forms for data processing control entry consistent in format? ATCCS 3.3.1

Are data entry fields grouped and ordered in a logical manner to facilitate performance of the task (e.g., ordered by importance, sequence, frequency)? 1472 D 5.15.4.3.2; S&M 1.4.27

Is there easy error correction for characters and fields? ATCCS 3.6.1

Is the movement of the cursor restricted to data entry areas during form filling? ATCCS 3.4.1

Can the cursor be moved easily from one area to another (e.g., by use of a tab key)? ATCCS 3.4.2

When a form is displayed, is the cursor automatically placed in the first character space of the first data entry field? ATCCS 3.4.4

Are data entry fields fixed in length with visual cues (e.g., limited number of entry spaces) given to indicate length? ATCCS 3.5.6

If more than one screen is used, are page numbers provided for each screen? ATCCS 3.7.1

Are unrelated data fields separated into different forms? ATCCS 3.7.2

Are messages and instructions on the form distinguished from data entry fields (e.g., by consistent location, highlighting)? ATCCS 3.7.4

Are boundaries and space used to separate data entry fields from other fields? ATCCS 3.7.5

Are optional data fields clearly labeled for the user? ATCCS 3.7.8

Are the labels for the data fields distinct and familiar to the user? ATCCS 3.8.1 & 3.8.5

Map and Situation Displays

General

When large geographic areas are displayed, is the earth's curvature consistently projected? ATCCS 8.1.1

Are situation displays presented as overlays on related map backgrounds? ATCCS 8.1.2

Are map labels placed consistently (e.g., beneath or within the feature)? ATCCS 8.1.3

Are significant features of maps labeled without cluttering the display? ATCCS 8.1.3

Is a consistent map orientation (e.g., north consistent for all maps) used throughout the system? ATCCS 8.1.4

Are map areas of special interest defined by the use of color, shading, texture patterns, or highlighting? ATCCS 8.1.5

Do the maps cover the areas of responsibility of the commanders at each echelon? ATCCS 8.2.1

Do the maps provide all essential details required to conduct operations? ATCCS 8.2.1

Are all critical features represented in the map? ATCCS 8.2.1.1

Are map labels legible at all display resolutions? ATCCS 8.2.1.2

Does the map display all critical areas of operation and activity of associated units (e.g., activities one echelon above and two echelons below, deep enemy units opposing friendly forces)? ATCCS 8.2.1.4

Are symbols placed on the map accurately or connected to the desired location using pointers (lines or arrows)? ATCCS 8.2.2.1

Are standard military symbols used in accordance to published guidelines and accepted doctrine? ATCCS 8.2.3.1

Where possible, are map symbols presented in a non-overlapping manner? ATCCS 8.2.3.4

Where possible, are displayed symbols accompanied by essential labels? ATCCS 8.2.3.5

If only a portion of a map is displayed, is a map inset used to show where the displayed area is within the larger map? ATCCS 8.2.4.2

On a map display, can the distance between points be determined easily? ATCCS 8.2.4.3

On a map display, can the bearing between points be determined easily? ATCCS 8.2.5.2

Is animation of graphics displayed smoothly? ATCCS 8.0

Pan & Zoom Functions

Does the panning function incorporate all aspects of the graphic? S&M 8.3

When panning a map display, can the displayed area be changed easily (i.e., by moving a window over the map in any direction)? ATCCS 8.3.1.1

Is an indicator used to show where the area being panned is located in the overall display (e.g., with a map inset)? ATCCS 8.3.1.2

During panning operations, can the user return to the starting point (original location on the map) easily? ATCCS 8.3.1.3

Does the zooming function reveal fine details of the graphic? ATCCS 8.3.2.2

When zooming a map display, can the user return easily to the normal display size? ATCCS 8.3.2.4

When zooming a map display, is an indicator provided showing the amount of change in the display? ATCCS 8.3.2.6

Is an indicator used to show where the area being zoomed is located in the overall display (e.g., with a map inset)? ATCCS 8.3.2.7

Is information used in map displays automatically updated? ATCCS 8.3.3

Can the user select categories of information to be updated? ATCCS 8.3.3.1

Are updates or changes in the map displays readily distinguished from other changes in the display (e.g., by highlighting the area)? ATCCS 8.3.3.3

Can the user control how often map displays are updated? ATCCS 8.3.3.4

Can the display be frozen to prevent further updates? ATCCS 8.3.3.6

Display Sequencing

Does display sequencing allow the user to selectively present and remove displayed data (e.g., series of overlays with different information)? ATCCS 8.3.4

Does display sequencing show temporal changes in the data base (e.g., changes in the tactical situation)? ATCCS 8.3.4

Can the rate of display sequencing be controlled by the user? ATCCS 8.3.4.1

Can display sequencing be paused or suspended? ATCCS 8.3.4.2

Is an indicator provided to show the status (e.g., pause) of sequencing operations? ATCCS 8.3.4.2

Is display sequencing presented in forward or reverse order? ATCCS 8.3.4.3

Can the user return easily to a selected display within a sequence of displays? ATCCS 8.3.4.4

Editing

Are symbols, labels, or other features added or deleted without destroying background information? ATCCS 8.4.5.1

Can the user expand areas of the display for placement of critical data? ATCCS 8.4.5.2

Can selected elements of a display be deleted, and can the deletions be restored? ATCCS 8.4.5.5

Standard Symbols and Graphics Library

Is a library of standard symbols and map graphics provided? ATCCS 8.4.1

Are symbols and map graphics easily labeled? ATCCS 8.4.2

Can new symbols and graphic overlays be created? ATCCS 8.4.3

Can symbols and graphic overlays be edited? ATCCS 8.4.5.3

Can a new library of symbols and map graphics be created? ATCCS 8.4.3

Direct Manipulation

Does the dialog type (i.e., menu, function keys) seem appropriately matched for the task at hand? S&M 3.1

Do operator interactive tasks use an appropriate input mode (e.g., mouse for menus)? DOD 7.1.1.4

Is a pointing device (e.g., mouse, joystick, trackball) used for most efficient interaction with the computer? DOD 7.1.1.1c

Is the user allowed to arrange windows and icons on the screen to meet individual task needs? DOD 7.1.1.2

Workstation Utilities

Are workstation resources provided to the user (e.g., print screen capabilities, access to common applications such as word processors, utilities such as clocks, user customization of interface)? DOD 4.1.5.1

Icon Usage

Does the icon represent its function appropriately (e.g., deleting file with a recovery capability would be represented by a trash can, deleting a file without recovery capability would be represented by a paper shredder)? DOD 7.1.3.9a

When an action has been initiated through an icon (e.g., printing), are non-selected icons disabled (i.e., they can not be manipulated)? DOD 7.1.3.2b

Can the user switch to a textual representation of an icon's functions or files? DOD 7.1.3.4

Is the meaning of icons consistent across displays and standardized throughout the system? DOD 7.1.3.7a

Are a common set of primitives (code that defines a specific shape, form, or color) and boundaries for icons used throughout the system? DOD 7.1.3.7b

Are labels provided for icons that distinguish their precise function? DOD 7.1.3.8b

Are the labels for icons placed underneath the icon? DOD 7.3.1.8b

Do the icon shapes represent concrete visual representations, not abstract concepts? DOD 7.1.3.9a

Are icon shapes simple and easily recognized? DOD 7.1.3.9b

Are the number of unique icon shapes limited in the system (i.e., no more than 20 unique shapes should be used)? DOD 7.3.1.9d

Is there a high contrast between icon boundary lines and the display background (i.e., boundary lines should be solid, closed, and easily discriminated from the background)? DOD 7.1.3.9e

Is the icon highlighted when selected? DOD 7.1.3.9f

Does the size of the icon allow easy positioning of the cursor to perform actions (icons should be at least 1\4 inch to reduce cursor positioning time)? DOD 7.1.3.10a

Windows

General

Are predefined windows, as in pull down menus, provided? ATCCS 7.1.2.2

Can several windows be displayed concurrently (i.e., overlapping like papers on a desk)? DOD 5.2.1.2a

Can windows be resized, moved, or overlayed? DOD 5.2.2.2 & 5.2.2.3

Do the contents of a window remain visible during resizing? DOD 5.2.2.4b

If several window overlays are displayed, is the active window indicated (e.g., window border changes color, change in labeling)? DOD 5.2.3.1

If more than one window is open, can the user shift easily from one window to another? DOD 5.2.3.2

Does the screen background provide a neutral pattern for overlapping windows? DOD 5.2.1.5c

If a window is static (i.e., cannot be resized), is the resize border removed to indicate its static status? DOD 5.2.2.4d

Are scrolling actions accomplished easily inside windows (e.g., by means of a scroll bar)? DOD 5.2.2.5

Do all windows have an identifying label that is descriptive of its contents? DOD 5.1.1.1a

If requested, can the user view an iconic or text map representation of all currently open windows including hidden windows? ATCCS 7.5.1

Are window titles located at the top of the window? DOD 5.1.1

Are window titles located consistently on all windows? DOD 5.1.1

Do titles of subordinate windows match the menu selection titles of the superordinate window? DOD 5.1.1.1d

Does the overlay of a temporary window allow activation of features in the active window (e.g., keys or other activation points)? DOD 5.2.1.3

If a temporary window is opened, is the information in the active window restored after the window overlay is removed? DOD 5.2.1.3c

Is the area provided for data entry, commands, or prompts placed at the bottom of the window display? DOD 5.2.1.5e

Are dialog boxes used consistently throughout the system (e.g., have the same look and function)? DOD 5.2.1.5f

Are control buttons for dialog boxes located at the bottom of the window? DOD 5.2.1.5f

Are control actions within a window (e.g., command entry) consistent from one window to another? DOD 5.2.2.1a

Are control actions for sizing and locating windows consistent from one display to another? DOD 5.2.2.1a

Do all subordinate windows and dialog boxes close automatically if the main applications window is closed? DOD 5.2.2.2b

Menus

General

Do the titles of the menus indicate the nature of the selections that can be made? DOD 6.5.2.3

Are menu instructions and error messages placed in the same position for every menu? DOD 6.1.2

Are menu options in a data entry display distinguished from other information (e.g., by highlighting, color)? DOD 6.1.5

Are menu options in a data entry display located consistently from display to display? DOD 6.1.5

Is immediate feedback given when an item from the menu is selected? DOD 6.4.1.4

Are menu functions grouped in terms of logical function, frequency, or criticality of use? DOD 6.3.3.2

Can any menu be reached directly by command without going through a sequence of menus? DOD 6.0

Is the number of menu responses minimized to reduce system menu selection times? DOD 6.1.1

Are two modes provided to make menu selections (i.e., keying in a number or letter code or placing the cursor at the option and selecting)? DOD 6.4.1.3

For code entry in menus, is code entry easily accomplished (e.g., providing a command entry area, allowing the user to enter an abbreviated form of the command or the full command)? DOD 6.4.1.5 & 6.4.1.6

For menu selection using a pointing device, is a large area provided for pointing provided (i.e., at least the area of the option label and a half-character distance around the label)? DOD 6.4.2.2

In selecting menu items, are letter and numeric codes separate in the dialog (i.e., the items should not be a mix of letters and numbers)? DOD 6.5.2.2

In numbered menu items, do the items start with "1" not "0"? DOD 6.5.2.4

Format

Are lists of menu and submenu items brief (i.e., no more than 5-0 options)? DOD 6.2.1.1

Are lists of menu and submenu items arranged in separate columns, aligned, and left justified? ATCCS 5.2.1.1

Are only those options available for the transaction displayed in the menu (i.e., unavailable or inappropriate options are not shown or are disabled)? DOD 6.2.1.8

Are menu options placed so that they do not overlap control functions? DOD 6.2.1.10

Menu Bars

Are menu bars used when the screen size is small to reduce cursor movement? DOD 6.1.6.1

Do menu bar options remain visible during all transactions? DOD 6.1.6.2

Pull-down and pop-up menus

Are pull down menus used instead of pop-up menus when cursor placement on the screen is not important for retrieval of information? DOD 6.1.7

Are the location of pop-up menus tied to the position of the cursor and pop-up near the item or menu being manipulated? DOD 6.1.8.1

Does a selected option from a pop-up menu remain highlighted? DOD 6.1.8.3

Hierarchial Menus

Are main and sub-menus arranged in a hierarchial order? DOD 6.3

Are hierarchic menus displayed in a consistent manner? DOD 6.3.2.4

In hierarchial menus, are critical or frequently selected items accessed immediately by the user? DOD 6.3.2.2

Are hierarchial menus easily navigated (e.g., by providing a system level menu of basic options, using simple control action to return to system level menu or to next higher level)? DOD 6.3.3

In hierarchial menus, are control options (e.g., undo, copy) distinguished from options that provide branching to other menu frames (e.g., e.g., block, move)? DOD 6.3.3.5

In hierarchial menus, are multiple selection paths provided to accommodate different levels of users (e.g., experienced users are allowed to use shortcuts for navigating menu structure)? DOD 6.3.3.7

When a sequence of menus must be traversed to make a selection, is the hierarchial menu structure designed to minimize the number of menus traversed (e.g., using a broad and shallow menu tree instead of narrow and deep menu trees, minimizing number of menu choices in the middle)? DOD 6.3.4.1

Function Keys

Are function keys provided for frequently performed control entries, tasks requiring a limited number of control entries, or interim control entries (actions taken before the completion of a transaction)? ATCCS 4.1.1

For a current task, are unneeded function keys temporarily disabled (i.e., unavailable to the user)? ATCCS 4.1.3

Are fixed function keys provided for critical functions (e.g., F1 for help)? ATCCS 4.0

For variable function keys (i.e., keys that control more than one function), is the actual or current meaning displayed through soft keys displayed on the screen? ATCCS 4.1.4

Are soft function keys displayed on the screen as close as possible to the actual keyboard function (e.g., at the bottom of the screen directly above the keyboard)? ATCCS 4.1.5

Is an alternate method of selection provided for soft keys (e.g., by clicking with a mouse)? ATCCS 4.1.6

If double keying is used (e.g., Ctrl, Shift), are the paired functions logically related to each other? ATCCS 4.3.1

Are function key labels distinctive and easily understood by the user? ATCCS 4.4.1

Are critical function keys (i.e., keys for emergency functions) located prominently and distinctly coded (e.g., by size or color)? ATCCS 4.5.1

Are frequently used function keys placed conveniently for the user? ATCCS 4.5.2

User Guidance

Is on-line help available from every screen? DOD 8.2.3.1

Is there a single keystroke access to and exit from help? DOD 8.2.2.1

Can beginner users request prompts for guidance and basic information? DOD 8.2.2.3 & 8.2.4.7

Can the item about which help is requested be specified by the user? DOD 8.2.1.1 & 8.2.7.1

Can an experienced user get guidance in selected areas, information on short cuts, system limitations? DOD 8.2

Is the use of jargon in help avoided? DOD 8.2.2.7

Is an alphabetical index of functions and commands available? DOD 8.2.4.1 & 8.2.4.2

Are different types of user guidance (i.e., titles, labeling, prompts, system messages) displayed consistently? DOD 8.2.8

Are prompts used to guide you in entering required data or control parameters? 1472 D 5.15.6.1

Does on-line help explain correct use of input options and related commands? DOD 8.2.6.2

Is on-line help context sensitive (i.e., help provides information on current actions)? DOD 8.2.6

Are help aids consistent from screen to screen (i.e., specific location on screen, consistent function key or button used)? DOD 8.2.8.1

Does the title of a help window reflect its content? DOD 8.2.9.1

Are error and help messages clear, concise, and appropriate to the user? DOD 8.2.9.4

Is the user able to "tag" specific help messages for later referral? DOD 8.2.10.1

Is the user shown how to navigate through help? DOD 8.2.4.5

Are successively more detailed explanations of an error message provided? DOD 8.2.5.2

Are special keys and key functions explained? DOD 8.2.66 & 8.2.7.4

Does help information reflect the current version of the software? DOD 8.2.11.1

Color Usage

Is color coding of information added to displays to augment monochromatic presentation of information? DOD 4.3.1.2a

Does the color coding provide easy discrimination between colors for users with normal and defective color vision (e.g., avoiding the use of green, red, and yellow as comparison for users with defective color vision, using brightness and saturation of color to enhance discrimination)? DOD 4.3.1.2d,e

Does the color coding enhance, not reduce, screen readability? DOD 4.3.1.1

Is color used consistently from screen to screen? DOD 4.3.2.2a

Is the color of a label consistent with its meaning (e.g., red used for ENEMY instead of blue)? DOD 4.3.2.2b

Is color coding based on conventional associations with particular colors (e.g., white for neutral, green for go or OK)? DOD 4.3.1.2c

Is a conservative number of colors used for coding (e.g., using no more than four colors at a time with a maximum of seven for alphanumeric screens, and four standard colors with a maximum of eight or nine on graphical screens)? DOD 4.3.2.3a

Are highly saturated colors (e.g., magenta and green, yellow and purple) avoided when employing color pairings? DOD 4.3.2.4a

Are contrasting colors (e.g., red and green, blue and yellow) used to emphasize different tactical information or text? DOD 4.3.2.4b

Are similar items coded with similar colors such as yellow and orange? DOD 4.3.2.4c

Is logically related information colored with similar hues? DOD 4.3.2.1b

Is there high contrast between foreground and background displays (e.g., black on light blue, blue on white)? DOD 4.3.1.1d

In presenting tactical information, is color used to distinguish important information (e.g., color used for more important information is brighter than adjacent colors)? DOD 4.3.1.2c

Is color coding avoided in small areas of the display where loss and bleeding of colors is likely to occur? DOD 4.3.1.2h

Is white used to highlight data? DOD 4.3.1.2i

Are unobtrusive colors used to display infrequently used information? DOD 4.3.1.1d

Are warm colors (e.g., orange) used to convey action and cool colors (e.g., blue) to convey status or background information? DOD 4.3.2.1d

Are appropriate colors used in ambient illumination (e.g., green provides good visibility for intermediate lighting, yellow for broad range of lighting, avoiding red under low lighting)? DOD 4.3.2.5

Are colors used consistently with their associated meanings (e.g., red for alert, critical information, enemy designation; green for non-alert, obstacles on map graphics; blue for friendly forces; yellow for forces or situation at marginal condition, caution, NBC areas on map graphics; black for friendly forces)? DOD 4.3.1.2c

Is the use of blue for small lines and dots avoided when a dark background is used? DOD 4.3.2.7

Are color keys provided when color usage deviates from associated meanings (e.g., red used to indicate other than alert)? DOD 4.3.2.8

In map graphics, are color codings of texture patterns or variations in tone ordered so that the darkest and lightest shades correspond to extreme values of the variable? DOD 4.3.3.2

Are standard military color codes used in maps? DOD 4.3.2.6

Sources:

Avery, L. W., Badalamente, R. V., Bowser, S. E., O'Mara, P. A., & Reynolds, S. E. (1990). Human factors design guidelines for the Army Tactical Command and Control System (ATCCS) soldier-machine interface. U.S. Department of Energy Pacific Northwest Laboratory: Battelle Memorial Institute.

Avery, L. W., & Bowser, S. E., (Eds). (1992). Human-computer interface style guide (Version 2.0), Department of Defense. U.S. Department of Energy Pacific Northwest Laboratory: Battelle Memorial Institute.

Smith, S. L., & Mosier, J. E. (1986). Guidelines for designing user interface software. Bedford, MA: MITRE Corporation.

Galitz, W. O. (1989). Handbook of screen format design (3rd ed.). Wellesley, MA: QED Information Sciences, Inc.

Appendix B

Interface Assessment Instrument

Interface Assessment Instrument

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Interactive Control Actions General Is an escape or exit function provided to easily abort a function or operation? DOD 8.3.1.14c				X		In most instances throughout system there is none (e.g. cannot stop overlay display drawings). Only AA Generation Tool has Abort Button
Can the information in the s[illegible] display be customized by the user (e.g., defining files [illegible]e to be displayed concurrently)? DOD 8.3.1.9				X		Fixed Menus only
Are control actions simple (completed with a minimum number of actions)? ATCCS 2.1.14.2			X			Still a lot of redundancy
Sequence Control Are control actions performed consistently throughout the system (e.g., enter functions the same from one task to another)? DOD 8.3.1.13			X			Exits from window still not consistent from one to another
Are step by step actions permitted for beginners? DOD 8.3.1.11			X			Only available in limited areas (i.e. Smart Palette - AA Generation Tool)
Are more complex command entries permitted for experienced users? DOD 8.3.1.11			X			e.g. AA Compare-specific section

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Interrupts Is a cancel option provided to remove any changes just made and restore the display to its previous state? DOD 8.3.4.9				X		
Is an interrupt command available to return system control to the user if the system locks up? DOD 8.3.1.16c				X		No - re-login always; no ESC-CTRL C key available
Cursor Does an "enter" action result in entry of all items regardless of cursor position? S&M 1.1.24	X					
Is the movement or resizing of a window indicated by a change in cursor shape? DOD 5.2.2.3b	X					
Is the cursor placed at the first (most likely) option at the appearance of each page or frame? DOD 8.3.3.7			X			Cursor must be moved manually by a click to fill in but sometimes it is available
Feedback Do all inputs consistently produce a perceptible response from the system? DOD 8.3.1.15d			X			Do not always know if system is responding
During lengthy transactions, is transaction status indicated? DOD 8.3.1.15c			X			In Unit Status Project tool only (not available system-wide)

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
When lengthy transactions are completed, does system indicate completion of transaction? DOD 8.3.1.15c			X			Only in instances where that capability exists
Error Feedback When entry errors are made, are constructive error messages provided stating what is wrong and what can be done? S&M 4.3.1			X			Only where capability is present (e.g. avenue selection - one of a few places it is available)
Are error messages specific enough? S&M 4.3.2			X			Only where capability is present - may not be good for novice user
Error Management Is user confirmation of entries that would destroy or alter data required? DOD 8.3.5.1			X			Not throughout whole system (e.g. available in Document Browser tool)
Are you warned of potential data loss? DOD 8.3.5.2			X			Not throughout whole system (e.g. available Document Browser tool)
To prevent data loss at log off, are you prompted to confirm the quit, save data files, or cancel the request? DOD 4.1.3			X			Can save individual pieces - not general logoff procedures
Are data files saved automatically at log off? 1472D 5.15.1.6				X		Not for individual pieces

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Is user input limited to appropriate input areas (e.g, invalid menu choices are grayed out and disabled)? DOD 8.3.5.15			X			Still a problem
Are undo facilities provided for all user selected operations? DOD 8.3.5.10				X		Not generally - undo provided in Document Browser tool only (but it doesn't work)
Can corrections be made easily to data entry errors (i.e., directly to the data entry and immediately following data entry? DOD 8.3.5.8	X					
System status Is some indication of system status (i.e., displayed clock, flashing cursor) provided at all times? DOD 8.3.4.6			X			Little and fat clock doesn't always appear; no permanent indication of status
Data Entry General Are your most frequent transactions the easiest to accomplish? S&M 1.0					X	
Is data entry designed so that it is easily accomplished? S&M 1.0	X					In Document Browser tool
Text Editing Can words, sentences, or paragraphs be copied in block form? S&M 1.3.23	X					In Document Browser tool

Can words, sentences, or paragraphs be moved in block form? S&M 1.3.2.3	X					
1 = Always 2 = Mostly 3 = Sometimes 4 = Never 5 = Not Applicable	1	2	3	4	5	**Comments**
Are you able to select and edit text with minimum difficulty and display edited text changes immediately? S&M 1.3	X					
Are text editing actions reversible? S&M 1.3.33			X			Undo does not work
Data Display General Is the text displayed in conventional use of mixed upper and lower case? S&M 2.1.6	X					
Are conventional rules of punctuation used? S&M 2.1.10	X					
Does display use simple sentence structure? S&M 2.1.13	X					
Does the system allow paging and scrolling? S&M 2.7.2.2		X				Capability of paging is not present; Document Browser tool window has different scrolling
Do labels of fields infer the data content of that field? S&M 2.2.4			X			Hard to figure out label in Edit Attributes function (label vs. name)

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Presentation Graphics Can data-driven graphics such as pie charts and bar charts be accomplished? ATCCS 9.6; S&M 2.4.5/2.4.4					X	Capability not current - only static charts available (cannot determine)
Are a variety of graphic attributes (e.g., colors, shading, texture patterns) available? S&M 1.6.12					X	
Is the graphic scale indicated when a display is shrunk or expanded? S&M 2.4.16					X	
Can the graphic be displayed exactly as it will be printed? S&M 2.4.20					X	
Tables Is tabular data organized in a recognizable fashion? S&M 2.3.2	X					

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Screen Design General Is information provided on the screen in a form that can be used by the user? DOD 4.2.1.4			X			Varies depending on tool (e.g. terrain overlays have too much data, lack legends to explain colors, etc.)
Are headers and other invariant fields placed consistently from screen to screen? DOD 4.2.2.2			X			Positions of Exit buttons and OK buttons vary from screen to screen
Are functional fields provided for program messages, error messages, and alarms? DOD 4.2.3.2f				X		Sometimes get pop-up error message in some functions
Are multiple pages used for displays with too much data? DOD 4.2.5.1					X	Scrolling only/no multiple pages
Are different elements in the display format easily distinguished (e.g., by color coding, spacing)? DOD 4.2.3.1			X			
Do abbreviations conform to accepted standards and conventions? DOD 4.2.3.1	X					
Is a title provided at the top of every page that describes its contents or purpose? DOD 4.2.3.2b			X			A title always exists, but it is not always best descriptor of contents
Are status and error messages, prompts, and command entry areas located at the bottom of screens? DOD 4.2.3.2e				X		Pop-up menu of errors sometimes appears

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Are large portions of text broken into small, meaningful groups or columns to improve readability? DOD 4.2.3.3a			X			
Column Displays Are alphanumeric columns left justified for rapid scanning? 4.2.3.3h	X					
In text columns, is the line length restricted (i.e., no more than 35-40 characters)? DOD 4.2.3.4b	X					
Data Protection General Is periodic back-up of data performed to minimize data loss and hardware failure? S&M 6.3				X		
Does the system require you to confirm data file deletions, or gross changes in the data? S&M 6.18			X			Almost non-existent
Form Filling Are data entry fields grouped and ordered in a logical manner to facilitate performance of the task (e.g., ordered by importance, sequence, frequency)? 1472D 5.1.15.4.3.2; S&M 1.4.27		X				

1 = Always 2 = Mostly 3 = Sometimes 4 = Never 5 = Not Applicable	1	2	3	4	5	Comments
Is there easy error correction for characters and fields? ATCCS 3.6.1	X					
Is the movement of the cursor restricted to data entry areas during form filling? ATCCS 3.4.1	X					
Can the cursor be moved easily from one area to another (e.g., by use of a tab key)? ATTCS 4.2	X					In general, available by mouse click only-only tabbing capability in Edit Attributes menu window
Map and Situation Displays General When large geographic areas are displayed, is the earth's curvature consistently projected? ATCCS 8.1.1					X	
Are situation displays presented as overlays on related map backgrounds? ATCCS 8.1.2	X					
Are map labels placed consistently (e.g., beneath or within the feature)? ATCCS 8.1.3		X				Static maps only
Are significant features of maps labeled without cluttering the display? ATCCS 8.1.3			X			More a function of scale
Is a consistent map orientation (e.g., north consistent for all maps) used throughout the system? ATCCS 8.1.4	X					

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Are map & overlay display areas of special interest defined by the use of color, shading, texture patterns, or highlighting? ATCCS 8.1.5	X					Map legend
Are all critical features represented in the map? ATCCS 8.2.1.1		X				Most are represented
Are map labels legible at all display resolutions? ATCCS 8.2.1.2			X			Shrink - pixel magnification of limited use
Are symbols placed on the map accurately or connected to the desired location using pointers (lines or arrows)?ATCCS 8.2.2.1	X					Uses lower left corner as standard placement
Are standard military symbols used in accordance to published guidelines and accepted doctrine? ATCCS 8.2.3.1		X				No arrow heads in avenues
Where possible, are map symbols presented in a non-overlapping manner? ATCCS 8.2.3.4		X				However, no capability to declutter when they overlap
If only a portion of a map is displayed, is a map inset used to show where the displayed area is within the larger map? ATCCS 8.2.4.2					X	System does not have this capability
On a map display, can the distance between points be determined easily? ATCCS 8.2.4.3	X					

1 = Always 2 = Mostly 3 = Sometimes 4 = Never 5 = Not Applicable	1	2	3	4	5	Comments
On a map display, can the bearing between points be determined easily? ATCCS 8.2.5.2					X	No system capability
Is animation of graphics displayed smoothly? ATCCS 8.0					X	No system capability
Pan & Zoom Functions Does the panning function incorporate all aspects of the graphic? ATCCS 8.3	X					
When panning a map display, can the displayed area be changed easily (i.e., by moving a window over the map in any direction)? ATCCS 8.3.1.1				X		
Is an indicator used to show where the area being panned is located in the overall display (e.g., with a map inset)? ATCCS 8.3.1.2				X		
During panning operations, can the user return to the starting point (original location on the map) easily? ATCCS 8.3.1.3			X			Not easy to do - function of guesswork
Does the zooming function reveal fine details of the graphic? ATCCS 8.3.2.2			X			Same amount of detail regardless of resolution - no additional detail
When zooming a map display, can the user return easily to the normal display size? ATCCS 8.3.2.4	X					

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
When zooming a map display, is an indicator provided showing the amount of change in the display? ATCCS 8.3.2.6				X		No, only indicator is window - spider itself-no indication of scale
Is an indicator used to show where the area being zoomed is located in the overall display (e.g., with a map inset)? ATCCS 8.3.2.7				X		
Can the user control how often map displays are updated? ATCCS 8.3.3.4					X	Not available in current configuration-no dynamic database
Can the display be frozen to prevent further updates? ATCCS 8.3.3.6					X	
Display Sequencing Does display sequencing allow the user to selectively present and remove displayed data (e.g., series of overlays with different information)? ATCCS 8.3.4					X	
Does display sequencing show temporal changes in the data base (e.g., changes in the tactical situation)? ATCCS 8.3.4					X	
Can the rate of display sequencing be controlled by the user? ATCCS 8.3.4.1					X	
Can display sequencing be paused or suspended? ATCCS 8.3.4.2					X	

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Is an indicator provided to show the status (e.g., pause) of sequencing operations? ATCCS 8.3.4.2					X	
Is display sequencing presented in forward or reverse order? ATCCS 8.3.4.3					X	
Editing Can the user return easily to a selected display within a sequence of displays? ATCCS 8.3.4.4					X	System only capable of having one map at a time currently
Are symbols, labels, or other features added or deleted without destroying background information? ATCCS 8.4.5.1	X					
Can the user expand areas of the display for placement of critical data? ATCCS 8.4.5.2	X					
Can selected elements of a display be deleted, and can the deletions be restored? ATCCS 8.4.5.5	X					Highlight can be restored - there is no simple deletion of an object (have to cut, exit/save overlay, go back in again). To delete, cut by overlay editor function, then save separately
Standard Symbols and Graphics Library Is a library of standard symbols and map graphics provided? ATCCS 8.4.1	X					
Are symbols and map graphics easily labeled? ATCCS 8.4.2			X			Through edit attribute only; cannot accomplish through free draw function; system does not prompt user for label name; can label phase line; could not add text in free draw

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Can new symbols and graphic overlays be created? ATCCS 8.4.3				X		Free draw not functioning
Can symbols and graphic overlays be edited? ATCCS 8.4.5.3	X					
Can a new library of symbols and map graphics be created? ATCCS 8.4.3			X			Have to be saved as overlay and on free draw - can create polygons or polylines but cannot label them (stored as part of overlay); cut/paste into a new overlay only
Direct Manipulation Does the dialog type (i.e., menu, function keys) seem appropriately matched for the task at hand? S&M 3.1		X				
Workstation Utilities Are workstation resources provided to the user (e.g., print screen capabilities, access to common applications such as word processors, utilities such as clocks, user customization of interface)? DOD 4.1.5.1			X			No print capability from FLC Advisor
Is a screen saver activated if the terminal has been idle for at least 3 minutes, and is deactivated by a user action? DOD 4.1.1	X					
Is the user allowed to arrange windows and icons on the screen to meet individual task needs? DOD 7.1.1.2				X		

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Do the contents of a window remain visible during resizing? DOD 5.2.2.4b		X				Lose scrolling bars when reducing size
If several window overlays are displayed, is the active window indicated (e.g., window border changes color, change in labeling)? DOD 5.2.3.1	X					
If more than one window is open, can the user shift easily from one window to another? DOD 5.2.3.2	X					
Does the screen background provide a neutral pattern for overlapping windows? 5.2.1.5c	X					
If a window is static (i.e., cannot be resized), is the resize border removed to indicate its static status? DOD 5.2.2.4d	X					Buttons present, can resize. Otherwise, no.
Are scrolling actions accomplished easily inside windows (e.g., by means of a scroll bar)? DOD 5.2.2.5		X				Document browser uses different scrolling; no indication of direction - left button = down, right button = up, middle = slide
Do all windows have an identifying label that is descriptive of its contents? DOD 5.1.1.1a			X			Not always descriptive
Are window titles located at the top of the window? DOD 5.1.1	X					

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Icon Usage Does the icon represent its function appropriately (e.g., deleting file with a recovery capability would be represented by a trash can, deleting a file without recovery capability would be represented by a paper shredder)? DOD 7.1.3.9a					X	Not general system capability. Only in plan folder objects (in plan folder)
Is the meaning of icons consistent across displays and standardized throughout the system? DOD 7.1.3.7a					X	
Are labels provided for icons that distinguish their precise function? DOD 7.1.3.8b					X	Plan folder products (yes)
Are the labels for icons placed underneath the icon? DOD 7.3.1.8b	X					
Is the icon highlighted when selected? DOD 7.1.3.9f	X					
Windows General Can several windows be displayed concurrently (i.e., overlapping like papers on a desk)? DOD 5.2.1.2a	X					
Can windows be resized, moved, or overlayed? DOD 5.2.2.2 & 5.2.2.3	X					

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Can any menu be reached directly by command without going through a sequence of menus? DOD 6.0				X		System not capable
Is the number of menu responses minimized to reduce system menu selection times? DOD 6.1.1			X			Mostly lots of redundant selection involved
Are two modes provided to make menu selections (i.e., keying in a number or letter code or placing the cursor at the option and selecting)? DOD 6.4.1.3			X			Only on certain menus is this available - generally no
Are lists of menu and submenu items brief (i.e., no more than 5-0 options)? DOD 6.2.1.1		X				Tools (10 selections) = too many; Document Browser main menu has 12
Are only those options available for the transaction displayed in the menu (i.e., unavailable or inappropriate options are not shown or are disabled)? DOD 6.2.1.8		X				Many unavailable options not disabled (e.g. AA Generation avoid NO-GO area button)
Are the location of pop-up menus tied to the position of the cursor and pop-up near the item or menu being manipulated? DOD 6.1.8.1		X				Not in all instances. One instance it is "tied to last position opened"
Does a selected option from a pop-up menu remain highlighted? DOD 6.1.8.3					X	Not applicable
Hierarchial Menus Are main and sub-menus arranged in a hierarchial order? DOD 6.3	X					

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Do titles of subordinate windows match the menu selection titles of the superordinate window? DOD 5.1.1.1d			X			Lots of problems (e.g. combat effectiveness)
If a temporary window is opened, is the information in the active window restored after the window overlay is removed? DOD 5.2.1.3c	X					
Is the area provided for data entry, commands, or prompts placed at the bottom of the window display? DOD 5.2.1.5e			X			(e.g. close, apply located at top of edit attributes window)
Are dialog boxes used consistently throughout the system (e.g., have the same look and function)? DOD 5.2.1.5f					X	Did not have time to look at all
Do all subordinate windows and dialog boxes close automatically if the main applications window is closed? DOD 5.2.2.2b		X				(e.g. combat effectiveness window when closed does not automatically close Task Organization subordinate window
Menus General Are menu instructions and error messages placed in the same position for every menu? DOD 6.1.2					X	Too few error messages and instructions to determine
Is immediate feedback given when an item from the menu is selected? DOD 6.4.1.4	X					
Are menu functions grouped in terms of logical function, frequency, or criticality of use? DOD 6.3.3.2			X			

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Are hierarchic menus displayed in a consistent manner? DOD 6.3.2.4					X	No time to determine
Are hierarchial menus easily navigated (e.g., by providing a system level menu of basic options, using simple control action to return to system level menu or to next higher level)? DOD 6.3.3	X					In pull downs - easily accomplished
When a sequence of menus must be traversed to make a selection, is the hierarchial menu structure designed to minimize the number of menus traversed (e.g., using a broad and shallow menu tree instead of narrow and deep menu trees, minimizing number of menu choices in the middle)? DOD 6.3.4.1			X			Have to go through 5 menus - then through windows to get to some overlays

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
User Guidance Is on-line help available from every screen? DOD 8.2.3.1			X			No - partially implemented - too numerous to mention
Is there a single keystroke access to and exit from help? DOD 8.2.2.1				X		In some instances can get help or key - "case sensitive". No key for exit available
Can beginner users request prompts for guidance and basic information? DOD 8.2.2.3 & 8.2.4.7			X			"Help on help" available from some screens
Can the item about which help is requested be specified by the user? DOD 8.2.1.1 & 8.2.7.1				X		Have to be in window - no way to do otherwise
Can an experienced user get guidance in selected areas, information on short cuts, system limitations? DOD 8.2					X	Not determined
Are help aids consistent from screen to screen (i.e., specific location on screen, consistent function key or button used)? DOD 8.2.8.1			X			Different menu structures buttons located in different places - too numerous to get
Are error and help messages clear, concise, and appropriate to the user? DOD 8.2.9.4					X	Help not implemented to a degree to determine
Is the user shown how to navigate through help? DOD 8.2.4.5					X	"Help on help" available is only partly implemented

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Are similar items coded with similar colors such as yellow and orange? DOD 4.3.2.4c					X	Cannot determine
Is there high contrast between foreground and background displays (e.g., black on light blue, blue on white)? DOD4.3.1.1d	X					
Is white used to highlight data? DOD 4.3.1.2i	X					
Are colors used consistently with their associated meanings (e.g., red for alert, critical information, enemy designation; green for non-alert, obstacles on map graphics; blue for friendly forces; yellow for forces or situation at marginal condition, caution, NBC areas on map graphics; black for friendly forces)? DOD 4.3.1.2c	X					
In map graphics, are color codings of texture patterns or variations in tone ordered so that the darkest and lightest shades correspond to extreme values of the variable? DOD 4.3.3.2					X	Capability not currently present

1=Always 2=Mostly 3=Sometimes 4=Never 5=Not Applicable	1	2	3	4	5	Comments
Are successively more detailed explanations of an error message provided? DOD 8.2.5.2			X			Some layering in AA Comparison Tool (combat power) needs more development
Color Usage Does the color coding enhance, not reduce, screen readability? DOD 4.3.1.1			X			(e.g. button color green, hard to distinguish from lettering)
Is color used consistently from screen to screen? DOD 4.3.2.2a			X			(e.g. colors don't match flat overlays - match in terrain corridors and arrows
Is the color of a label consistent with its meaning (e.g., red used for ENEMY instead of blue)? DOD 4.3.2.2b					X	Not enough time to really determine
Is color coding based on conventional associations with particular colors (e.g., white for neutral, green for go or OK)? DOD 4.3.1.2c		X				Accept button is green, but means "no action" "grid spacing configuration" window
Is a conservative number of colors used for coding (e.g., using no more than four colors at a time with a maximum of seven for alphanumeric screens, and four standard colors with a maximum of eight or nine on graphical screens)? DOD 4.3.2.3a			X			Problem in graphics screens - no legends available
Are highly saturated colors (e.g., magenta and green, yellow and purple) avoided when employing color pairings? DOD 4.3.2.4a		X				Problem with erratic in color configuration overlay - uses magenta yellow/green
Are contrasting colors (e.g., red and green, blue and yellow) used to emphasize different tactical information or text? DOD 4.3.2.4b		X				

Appendix C

Glossary of Abbreviations and Acronyms

Appendix C

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AA	Avenue of Approach
AACT	Avenue of Approach Comparison Tool
ALBM	AirLand Battle Management
AMC	Army Materiel Command
ARI	Army Research Institute
ATCCS	Army Tactical Command and Control System
ATD	Advanced Technology Demonstration
BA	Battlefield Area
BCBL	Battle Command Battle Laboratory
CAC	Combined Arms Command
C&C	Cover and Concealment
CHS	Common Hardware Software
COA	Course of Action
DOD	Department of Defense
DTED	Digital Terrain Elevation Data
EM	Execution Monitor
ESC	Enemy Situation Capabilities
FDRS	Functional Description Requirements Specification
FITE	Force Interactive Tactical Evaluator
FLC	Force Level Control
FM	Field Manual
FSC	Friendly Situation Capabilities
GIS	Geographic Information System
GUI	Graphic User Interface
ITD	Interim Terrain Data
LAN	Local Area Network
MAUA	Multi Attribute Utility Analysis
MCS	Maneuver Control System
MET4	Mission, Enemy, Terrain, Troops and Time Available Tools
OCOKA	Observation and Fire, Cover and Concealment, Obstacles, Key Terrain, Adequacy of Maneuver Space
OSF	Open Software Foundation
OPORD	Operations Order
PEO-CCS	Program Executive Office for Command and Control Systems
SD	Standard Deviation
SME	Subject Matter Expert
SMI	Soldier Machine Interface
TDA	Tactical Decision Aids
TRADOC	Training and Doctrine Command